DOCUMENT RESUME

ED 247 883 IR 011 232

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TITLE School of the Air by Satellite. A Study of the Improvement of Distance Education in North-west Queensland Using the Australian Communications Satellite System.
INSTITUTION Queensland Dept. of Education, Brisbane (Australia).
PUB DATE Sep 83
NOTE 105p.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS *Communications Satellites; Delivery Systems; *Distance Education; *Educational Administration; Feasibility Studies; Foreign Countries; *National Programs; Program Development; Program Implementation; *Regional Programs
IDENTIFIERS *School of the Air (Australia)

ABSTRACT

As part of an assessment of the educational uses of the Australian Communications Satellite System to be launched in mid-1985, this report focuses on the Mount Isa School of the Air. A general discussion assesses the mechanisms for delivery of distance education for isolated students in Northwest Queensland and considers possible functional regroupings of the existing services provided by the Primary Correspondence School, Schools of the Air, The Loan Video Scheme, the Itinerant Teacher Service, the Contact Teacher Service, Activity Days, and the Priority Country Area Program. Existing services in the Northwest Region are evaluated, including technical and educational resources. Two possible directions for change are considered--strengthened centralism and strengthened regionalism. Using assessment criteria, a preference is indicated for strengthened regionalism as a means of increasing the quality and variety of distance education services. It is suggested that a regionalized functional regrouping of services could be achieved using the idea of a School of Distance Education as the coordinating center for correspondence papers, School of the Air lessons, activity days, Itinerant Teachers services, and other special projects. Nineteen figures are included, and a discussion of the satellite link design is appended. (LMM)

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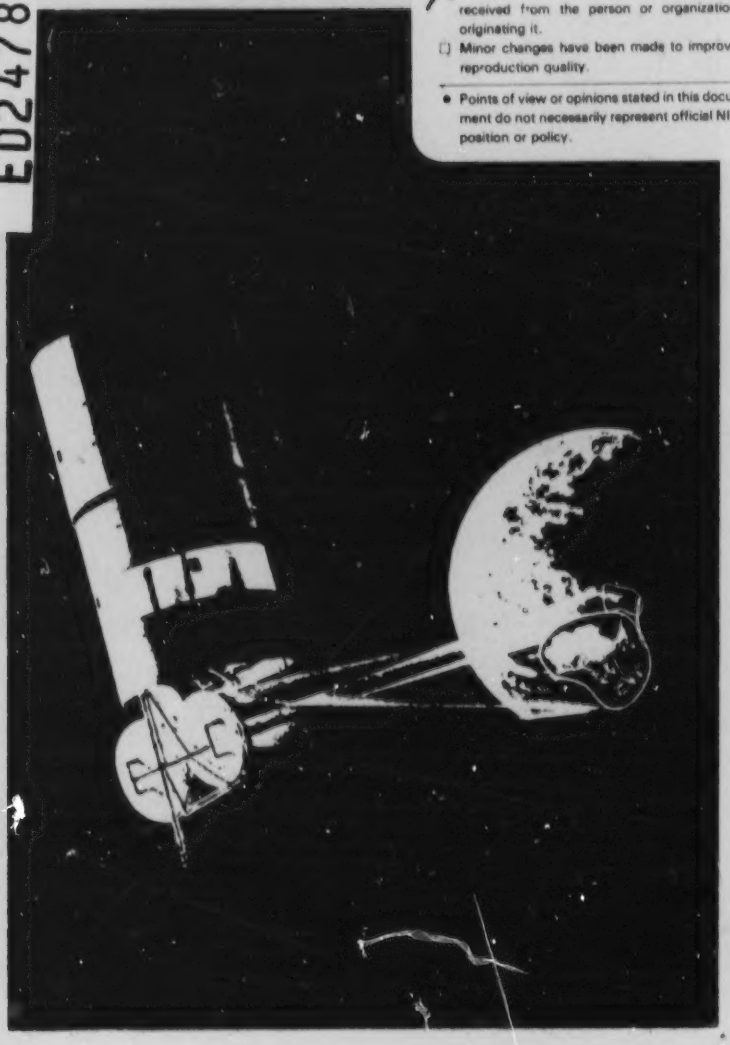
SCHOOL OF THE AIR BY SATELLITE



A study of the improvement of distance education in North-west Queensland using the Australian Communications Satellite System

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For the
Queensland Department of Education
and the
Commonwealth/State Advisory Committee on the
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SEPTEMBER 1983

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TABLE OF CONTENTS

Page

ii Glossary

iii List of Figures

iv List of Photographs

v Executive Summary

1 Chapter 1 : Background - The focus and conduct of the study

5 Chapter 2 : Mechanisms for delivery of distance education for primary students in Queensland:

- 2.1 Distance education services
- 2.2 Needs of distance learners
- 2.3 Curriculum planning
- 2.4 Assessment of service delivery

21 Chapter 3 : Existing services in the North-west region:

- 3.1 Educational resources
- 3.2 Technical resources
- 3.3 Assessment of North-west services

34 Chapter 4 : Service improvement through strengthened centralism:

- 4.1 Administrative Structure
- 4.2 Technical Factors
- 4.3 Assessment

43 Chapter 5 : Service improvement through strengthened regionalism:

- 5.1 Administrative Structure
- 5.2 Technical Factors
- 5.3 Assessment

52 Chapter 6 : Preferred scenario:

- 6.1 Educational Factors in the Scenario
- 6.2 Technical Implementation
- 6.3 Assessment

66 Chapter 7 : A trial introduction of improved service:

- 7.1 The need for a trial
- 7.2 Educational elements

70 Chapter 8 : Recommendations

APPENDIX A : Satellite Link Design for School of the Air and Enhanced Educational Uses

GLOSSARY

ACSS	Australian Communications Satellite System Launched in mid-1985. Owned and operated by AUSSAT Pty Ltd
DRCS	Digital radio concentrator system
HACBSS	Homestead and community broadcasting satellite service
HF Radio	High frequency shortwave radio used for two-way communications
ICPA	Isolated Childrens' Parent's Association
ICSEU	Isolated Childrens' Special Education Unit of the Queensland Department of Education
MCES	Major city earth station
PCAP	Priority Country Area Program
PCS	Primary Correspondence School
RFDS	Royal Flying Doctor Service
RTSS	Remote Telephony Satellite Service
SOTA	School of the Air

LIST OF FIGURES

Page	Figure	
13	2.1	"Needs" of Learners
18	2.2	Elements of learner needs
19	2.3	Fundamental elements of teaching and learning
21	3.1	Educational regions in Queensland
21	3.2	Distribution of Mount Isa SOTA students
23	3.3	Existing interaction of distance education resources in North-west Queensland
25	3.4	Itinerant and Contact Teacher areas
33	3.5	Assessment of existing North-west services
37	4.1	Strengthened Centralism
39	4.2	Communications links for centralised distance education
42	4.3	Assessment of strengthened centralism
47	5.1	Strengthened regionalism
49	5.2	Communications links for regionalised distance education
51	5.3	Assessment of strengthened regionalism
53	6.1	Evaluation of the distance education scenarios
56	6.2	Communications flow at Mount Isa SOTA
60	6.3	Notional utilisation of a 12-watt transponder in the national beam
61	6.4	Notional utilisation of a 12-watt transponder in the North-eastern zonal beam
69	7.1	Outline of activities for a Mount Isa SOTA satellite trial

LIST OF PHOTOGRAPHS

Page	
3	Discussions at the Mount Isa School of the Air between Mr Tom Robertson and Mr Dennis Josefski with Mr Gillam
4	Teacher-in-Charge, Mount Isa School of the Air, Ms Tilley, at the teacher's console in one of the three studios
6	Mount Isa School of the Air building
8	Portion of Brisbane-based Loan Video Scheme tape duplication centre in the Production Services Branch of the Queensland Department of Education. Head of the Branch, Mr Kitt, shows Mr Davies the facility
12	PCAP vehicle used by a team of Itinerant Teachers
57	An Australian-built 2.4 metre earth station at the Department of Communications test site at Alice Springs
64	Traditional SOTA transceiver

EXECUTIVE SUMMARY

The Queensland Department of Education and the Commonwealth/State Advisory Committee on the Educational Use of Communication Technology requested this Report in April 1983 as an input to their consideration of the educational uses of the Australian Communications Satellite System to be launched in mid-1985. It was agreed that the Mount Isa School of the Air would be the focus of the study.

The Report assesses the variety of educational services available to isolated students in North-west Queensland and considers possible functional regroupings of the existing services provided by:

- Primary Correspondence School;
- School of the Air;
- Priority Country Area Program;
- Loan Video Scheme

Two possible directions for change are considered: strengthened centralism and strengthened regionalism. Using the assessment criteria developed in this Report, a preference is indicated for strengthened regionalism as a means of increasing the quality and variety of distance education services. It is suggested that a regionalised functional regrouping of services could be achieved using the notion of a School of Distance Education as the co-ordinating centre for Correspondence papers, School of the Air lessons, activity days, Itinerant Teachers and other special projects.

The achievement of improved communications for isolated students will come gradually as private-line telephony and satellite links become available. Two-way radio will be required for many years

to provide services for students who move frequently or enrol only for short durations. A School of the Air, however, could operate classes successfully by integrating the existing two-way radio operations with telephony and satellite links. This integration might take several years while students were progressively equipped with telephone terminals or satellite earth stations and while the notion of a School of Distance Education was established.

The introduction of satellite communications offers more than just an improvement in the existing two-way radio channels between teachers and students. The Australian Communications Satellite System has facilities useful in providing isolated students with educational television and access to computer-based services. The challenge for educators is to take full advantage of the potential in the new communications technologies.

This Report indicates that, in pursuing the notion of a School of Distance Education, ways can be found to successfully integrate new administrative arrangements and new communications technologies to provide better educational services to isolated students in the North-west Region of Queensland.

Change is always unsettling and changes involving functional and technical rearrangements need to be carefully introduced so that all concerned may become familiar with the altered procedures.

The environment of the Schools of the Air in Australia is unique and there are still uncertainties about how best to achieve the notion of a School of Distance Education and to integrate two-way radio, telephony and satellite communications. In many disciplines, trials are undertaken to gain familiarity with a new system, evaluate the total cost of the system and reduce the uncertainties in deciding upon a full-scale implementation. A trial introduction of a School of Distance Education using a combination of two-way radio, telephony and satellite technologies would fulfil these purposes.

It is recommended that the Queensland Department of Education:

a) Assess the desirability of entering into a one-year trial service to commence in January 1986;

b) Enter into discussions with AUSSAT on the terms and conditions for a trial;

c) Plan, in co-operation with the Advisory Committee and other interested Departments of Education, the initiation of operational services in an evolutionary fashion in January 1987.

Initial discussions have been held with AUSSAT and AUSSAT has offered assistance with a trial.

CHAPTER 1

1.1 Background

The Australian Education Council at its 44th meeting in October 1981 endorsed a proposal submitted by the Conference of Directors-General of Education that a program of trials of the educational use of communications technology be undertaken, including an assessment of the educational potential of the Australian Communications Satellite System.

A Commonwealth/State Advisory Committee on the Educational Use of Communications Technology, chaired by the Commonwealth with representatives of all States and Territories, was subsequently formed. In the course of its meetings, the Advisory Committee recognised the need for information on the technical options for satellite transmission and on projected costs. The Commonwealth Department of Communications offered in October 1982 to assist the the Advisory Committee by developing communications models using the Australian Communications Satellite System primarily in applications related to Schools of the Air but including other enhanced educational services. A School of the Air Subcommittee was formed to advise on educational aspects and to steer the direction of the communications system modelling.

A report titled "Potential Use of the Australian Satellite Communications System for School of the Air and Enhanced Educational Services" by Mr George Davies and Mr John Gillam of the Department of Communications was submitted to the Committee in March 1983 and distributed to the Directors- General of Education. The report outlined a number of technical options which could be considered by Departments of Education interested in applying satellite communications to the operation of Schools of the Air and enhanced educational services.

In April 1983, the Queensland Department of Education sought the support of the Advisory Committee and the Department of Communications to carry out a further study which was to apply to a specific School of the Air using the general principles developed in the earlier study. The Mount Isa School of the Air was proposed for the study and the Advisory Committee agreed. Furthermore, they concurred with the Department of Communications that the study should be applicable to other State Departments of Education. The joint study was to be carried out by Mr John Kitt of the Queensland Department of Education and Messrs Davies and Gillam of the Department of Communications. Work commenced in late April and culminated in July 1983 with the preparation of this Report.

The Queensland Department of Education formed two Reference Groups to advise the study team. The groups gave guidance on matters related to the objectives of the study and details about distance education conditions in the North-west of Queensland.

Members of the Reference Groups were:

CENTRAL REFERENCE GROUP (Brisbane):

Mr Bill Hamilton	Deputy Director-General (Chairman) Queensland Department of Education
Mr Des Eastment	Staff Inspector, Primary Education
Mr Dennis Josefski	Supervisor, Primary Correspondence School
Mr Ron Boxall	Senior Research Officer, Curriculum Branch
Mr John Kitt	Supervisor, Production Services Branch
Mr Mark Stoneman	ICPA, Immediate Past President

MOUNT ISA REFERENCE GROUP:

Mr Tom Robertson	Regional Director, North-west (Chairman)
Mr Ray Powell	Regional Inspector, North-west
Ms Loody Tilley	Teacher-in-Charge, Mt Isa SOTA
Mr Dennis Josefski	Supervisor, Primary Correspondence School
Mr John Kitt	Supervisor, Production Services Branch
Mrs Christine MacDonald	School of the Air Parent, "Devoncourt" Cloncurry
Ms Dorothy Dean	Regional Coordinator, North-west Priority Country Area Program (from 10 May 1983)

The study team met with the Central Reference Group on 26 April 1983 and spent two days with the Mount Isa Reference Group on 27-28 April 1983. While in Mount Isa, members of the Study Team had informal discussions with local personnel of the Royal Flying Doctor Service and Telecom Australia. A further meeting of the Mount Isa Reference Group was held in Brisbane on 10 May 1983 to consider initial service models.

Discussions at the Mount Isa School of the Air between Mr Tom Robertson (left) and Mr Dennis Josefski (right) with Mr Gillam

During the study, the Department of Communications liaised with the Rural and Remote Networks Branch of Telecom Australia and with AUSSAT Pty Ltd. The frank and open advice that was provided assisted greatly in the development of this Report.

The overall Terms of Reference for the study were:

- to further develop the concept of the use of the domestic satellite by Schools of the Air;
- to introduce enhanced educational services through integration in the use of the satellite;
- to develop cost estimates;
- to outline an evolutionary introduction of satellite services.

This report covers educational and technical matters but cost estimates need the benefit of further study as part of the lead up to the satellite trial suggested in the report.

Teacher-in-Charge, Mount Isa School of the Air, Ms Tilley, at the teacher's console in one of three studios

CHAPTER 2

MECHANISMS FOR DELIVERY OF DISTANCE EDUCATION FOR PRIMARY STUDENTS IN QUEENSLAND

2.1 Distance Education Service

The Queensland Department of Education seeks to provide the highest quality educational service possible to all students, irrespective of their location, having due regard to individual social, intellectual and physical development.

Distance education services are provided by the Department for primary students who are geographically isolated, who cannot attend school for medical reasons, who are members of highly itinerant families, or who have ministerial approval for withdrawal from regular school situations. A variety of agencies are involved in providing a range of distance education services in Queensland.

Primary Correspondence School (PCS)

The Primary Correspondence School is recognised as the prime Departmental agency for the provision of educational services for isolated children. The School's operation largely involves the provision of instruction papers with written assignments which are completed by learners and returned to the School for assessment. Lesson papers are designed to reflect the curriculum offerings in regular schools, thus the PCS is involved in the interpretation and translation of curriculum guides and syllabuses into units of work.

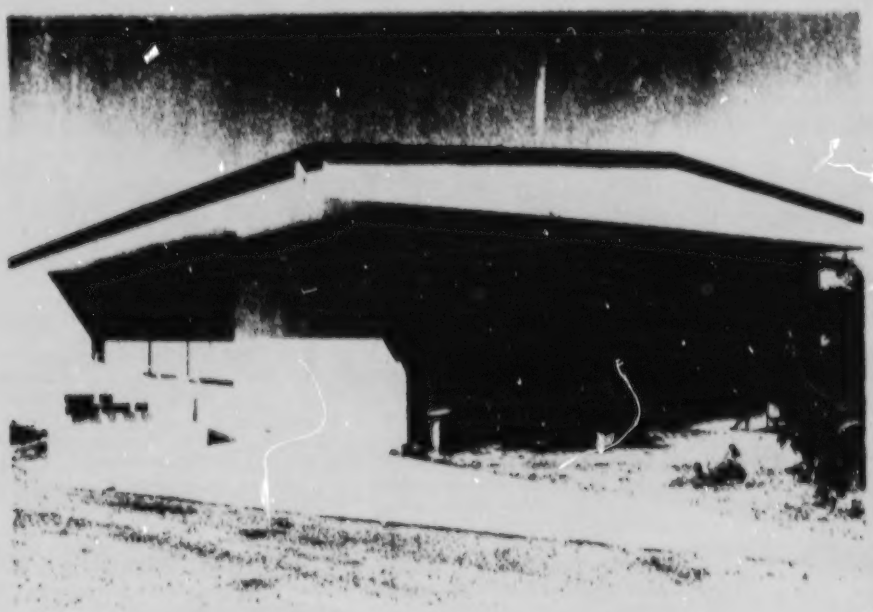
Instruction provided includes:

- sequential papers for each year in each of the compulsory subjects Mathematics, Langauge Arts, and Social Studies;

- optional teaching programs in Science and Art for years 3 to 7. (Art is an integral part of the compulsory program for Years 1 and 2);

- Audio cassettes which supplement written papers.

The PCS despatches papers, tapes and other resources to students who complete assignments and return them for assessment. Remediation and supplementary material for enrichment and extension is also provided by PCS teachers. Where serious weaknesses are detected, PCS teachers advise Itinerant Teachers, School of the Air and the Isolated Children's Special Education Unit for back-up services.



Mount Isa School of the Air building

School of the Air (SOTA)

Some geographically isolated students of the PCS are also enrolled with SOTAs located at Charleville, Mount Isa and Cairns. The SOTAs provide complementary and supplementary services to those provided by the PCS.

The role of the SOTAs includes support for Home Tutors in the interpretation of PCS papers, development and enrichment of oral communications, motivation of children working from PCS papers, identification of learning and speech difficulties, and provision of an avenue of socialisation through the daily contact period as well as specifically arranged activity days.

Class contact time for students of the SOTAs is usually 30 minutes per day although individual student contact time is obviously considerably less.

PCS papers shape the SOTA lessons for a considerable proportion of the week's work because:

- SOTA lessons must be built on content which is suitable to the majority of the class. A recapitulation of the previous PCS papers tends to be used as 'safe' content

- All students need to have access to common resources. PCS papers provide that commonality

- Lengthy explanations of difficult content are not easy 'on air'. Teachers choose the familiar content of the PCS papers on which to build a lesson.

Isolated Children's Special Education Unit (ICSEU)

The role of the ICSEU in distance education services includes:

- delivery of special education services to educationally handicapped children enrolled with the PCS;

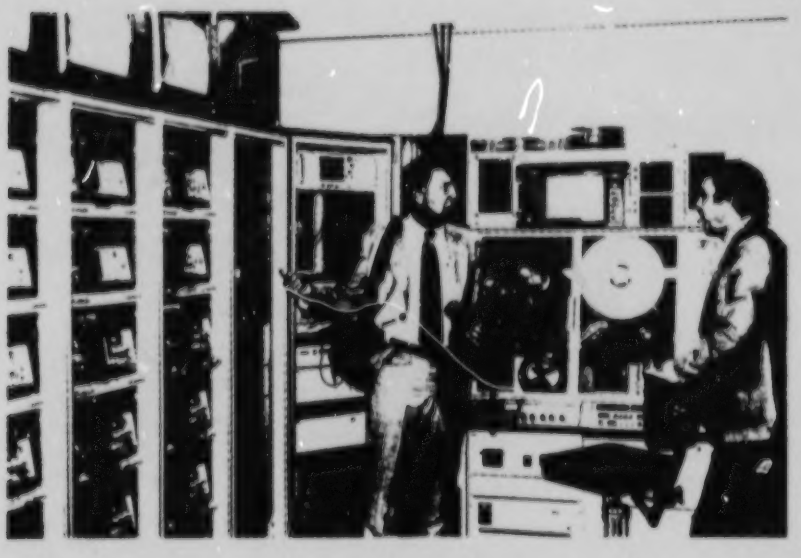
- support for the children's Home Tutor;

- professional support for PCS teachers, SOTA teachers and Itinerant Teachers;

- design and production of support materials to help meet the needs of children with special learning needs in isolated areas;

- design and production of materials for teachers and Home Tutors of children with special learning needs;

- liaison with the Special Education Division of the Queensland Department of Education and the Health Department for services which may be accessed on behalf of a child.



Portion of Brisbane-based Loan Video Scheme tape duplication centre in the Production Services Branch of the Queensland Department of Education. Head of the Branch, Mr Kitt (right), shows Mr Davies the facility.

Loan Video Scheme

In 1980, the Commonwealth Government agreed to fund a three-year pilot program to provide video facilities for loan to isolated children living outside areas covered by normal television transmissions, commencing with students enrolled with SOTAs. The

Government of Queensland accepted funding provided for this program on the basis that all children enrolled with SOTAs would be provided with the service. The Queensland Department of Education has made available video programs as visual support in the home learning environment. Programs are selected from the Australian Broadcasting Corporation schools' television programs, as well as from other sources. They are duplicated and supplied to families on a fortnightly basis.

Care has been taken in the design of the Loan Video Scheme to ensure that support, in a teaching sense, has been provided by teachers of SOTAs. Also, integration with PCS papers is an objective of the scheme.

Itinerant Teacher Service

The purpose of the Itinerant Teacher service is to assist Home Tutors with the education of children who are enrolled in the PCS. Professional assistance is given to students and tutors to improve their ability to cope with education by correspondence. Operation of the Itinerant Teacher service involves home visits by teachers. Itineraries are planned several weeks in advance and families are notified by telephone or SOTA broadcasts.

Various forms of assistance are provided by Itinerant Teachers:

(a) Learning/teaching problems faced by pupils or Home Tutors can be discussed;

(b) Demonstration lessons are presented for the Home Tutors;

(c) Home Tutors are shown where current skills being learned fit into the curriculum;

(d) Daily schedules related to children's age level and attention span are developed;

(e) Children's standards are assessed and -

(1) areas of weakness discerned with suitable programs for correction given for practice; and

(2) the pressures imposed by over-anxious parent Home Tutors can be assuaged when the child is shown to be working well;

(f) Parents and pupils are familiarised with -

(1) resources available through the PCS;

(2) additional materials available as aids to the teaching process;

(3) funds available through government and other funding agencies; and

(4) resources available through other sources (e.g. Scoutreach, Lone Guide);

(g) Requests from PCS teachers can be emphasised to help overcome the lack of face-to-face communication with each child's PCS teacher.

Serious remedial problems are referred to the ICSEU.

Contact Teacher Service

The Contact Teacher service, which is unique to the North-West Region, was established to make use of the regular visits which some families make to Winton and Cloncurry for business purposes, e.g. sale days.

Services provided by Contact Teachers include -

- consultative support for Home Tutors
- diagnostic and remedial services for students
- experiences for children in school classes
- monitorial services (while families conduct business, children are supervised)
- referral to specialised services
- a phone answering service available daily for consultation and immediate problem solving.

Activity Days

Activity days are arranged to allow several families to bring their children together in a larger centre where there are opportunities to:

(a) meet with other children living and learning under similar conditions; and

(b) participate in several creative expression activities not included in PCS papers but which occur in schools; such as folk dancing, drama exercises, singing, playing of musical instruments, group and individual art activities, and story telling.

Priority Country Area Program (PCAP)

The delivery of services to isolated primary-aged students in Queensland is complemented by the initiatives undertaken by PCAP. This Program was initiated in 1978 as a result of the Commonwealth Government providing, on the recommendation of the Schools Commission, funds to improve the educational services to children educationally disadvantaged because of their location in particular country areas. The PCAP services are provided to both State and non-State schools.

Services sponsored by PCAP for isolated students (including SOTA students) cover:

- Itinerant teachers
- Summer schools
- Speech therapy
- Mini schools
- Mobile schools
- Cultural activities
- Isolated Children's Special Education Unit (contribution)
- Contact teachers
- Distance education seminars

Management of the PCAP projects is maintained by a Committee chaired by the Regional Director of Education so that there will be co-ordination of initiatives with Departmental and other services.

PCAP vehicle used by a team of Itinerant Teachers

2.2 Needs of Distance Learners

In providing quality educational services through these agencies to all learners, irrespective of their location throughout the State, the Queensland Department of Education recognises that individual learners need to develop knowledge, skills, understandings and attitudes. Because of the emphasis which historically has been placed on skills acquisition through Correspondence Education, only that area is dealt with in this Report. Described in broad and imprecise terminology, these skills-related needs are:

(a) Academic Skills and processes: which include basic skills in language and numbers.

(b) Social Skills: which include oral and written communication, inquiry, reference skills, co-operating with others, accepting responsibility, assuming leadership and participating in group work.

(c) Affective - Creative Experiences and Skills: including experiences in art, music, drama, physical education, recreation and sport.

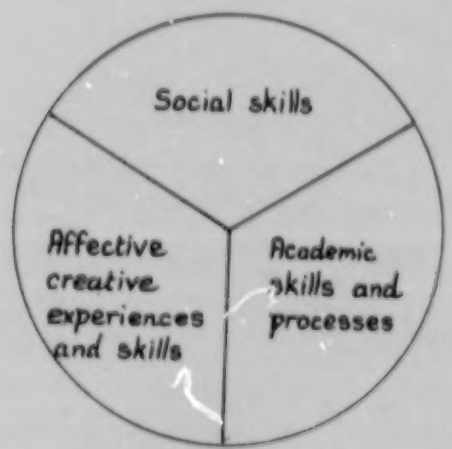


FIGURE 2.1 - "Needs" of Learners

Modern educational thought would support the view that a balanced satisfaction of these needs of individual learners results in the holistic development of the child. While varying emphasis may be given to each of the needs at any particular stage of student development, recognition must be given to each need and provision made for development in that area.

An often forgotten requirement for the isolated learner is an educational system which harmonises with the lifestyle of the learner. The original correspondence service happened to use a technology (paper and mail services) which is time-independent and flexible enough to fit the lifestyle of learners. Children have some freedom in completing their lessons as long as the papers are completed within a reasonable time and the sequence of papers is not significantly disturbed.

With the introduction of SOTAs came the time-dependence of scheduled broadcasts. This has resulted in:

- some families electing not to enrol with the SOTA;
- some children being irregular attenders at on-air sessions.

The evidence for these statements is anecdotal and not quantified but the reality of the situation is well recognised.

The realities of lifestyle cannot be ignored nor the extent to which they can impose limitations on participation in educational programs underestimated. To do so, is to disregard the reality of the social circumstances of the isolated. In designing alternative educational services for isolated children, the quest for some time-independence needs to be considered very seriously if families are not to be forced out of educational programs. The type, nature and delivery of distance education accommodate educational and social requirements.

2.3 Curriculum Planning

In implementing curriculum provisions in the regular classroom, the teacher applies principles of learning on which general agreement exists among educators. Among these principles are:

- Motivated learners acquire new skills and knowledge more readily than those who are not motivated
- Active participation by learners is preferable to passive reception
- There is no substitute for repetitive practice in the over-learning of skills.
- Transfer of skills to new tasks will be better if the learners can discover the relationships themselves using a variety of situations.

Through daily interaction, the teacher in the classroom develops a broad view of the child, his characteristics and abilities and, within the dynamic environment of the classroom, applies appropriate strategies to allow the student to satisfy needs.

Irrespective of whether educational services are provided in a regular classroom or distance mode, the following elements are essential:

(a) Organisation of Learning - (how learning activities are related to each other or time organised)

Learners using distance education can more freely choose when to engage in learning activities. Flexibility in organisation is a notable aspect of distance education.

(b) Motivation - (the force which mobilises learning)

In the regular classroom, direct participation is part of the teacher/student interaction. The pattern of children attending school from 9.00 am to 3.00 pm organises behaviour and contributes a major motivational effect.

The environmental conditions in distance learning contribute a negative motivational effect. Variety is the characteristic of the environment in the distance mode and thus there is no pre-condition to learning. Further, the isolated learner does not have social motivation such as competition or the desire for status in the teacher's presence. Teachers are not in a position to adjust the learning task or materials to the momentary situation of the learner. The distance learner's motivation seems largely determined by previous success or failure and the expectation of success or failure.

(c) Learning Processes - (the forms of learning which learners engage in)

In distance education, the effectiveness of stimulus/response modes of learning is limited because of the delay in response to stimulus in student/teacher interactions. The necessity for rapid response times is of particular importance to young learners.

Learning by imitation often involves copying behaviour models. In the distance mode, the learner often does not have the benefit of either fellow learners or teachers as models.

Learning by identification is similar to learning by imitation but values, attitudes and personal characteristics play an important role. In face-to-face situations, such contacts can support or inhibit learning. Distance education strives to achieve the same thing by using appropriate communication processes.

(d) Communication Processes - (the manner in which teachers and learners exchange ideas and information)

Clearly the most obvious aspect of distance education is that its communication processes are not face-to-face. Teacher and learner exchange information usually in written form, less frequently in spoken language and almost never in non-verbal form.

Communications are formal, planned and with emphasis on content. Teachers seldom have the capacity to modify the flow of information on the basis of moment-to-moment feedback from the learner.

(e) Didactic Activity and Materials - (teaching activities and materials)

Although the activities and materials used by the distance teacher to facilitate learning suffer the disadvantage of not being easily modifiable as the result of learner reactions, their major strength lies in the fact that they can be developed carefully and are often well organised, clear and striking. On the other hand, they can be formal, impersonal and rigid.

(f) Evaluation

The effectiveness of learning activities is largely influenced by the information received about the assessment of performance. Information received may vary from informal feedback to formal evaluation. Motivation and attitude to the content of what is being learned is affected by the feedback. Evaluation plays a part in determining future didactic activities and the rate at which a learner progresses through a system.

Feedback and evaluation in the distance education mode is often delayed and formal.

2.4 Assessment of Service Delivery

A number of comments can be made regarding the major elements of the distance education service provided in Queensland (PCS, SOTA and Itinerant Teachers) with respect to the needs of learners as identified in Figure 2.1. These comments are shown in Figure 2.2. The comments are derived from evaluation criteria established in the Queensland Department of Education's PCAP Evaluation Series and the Research Branch's Evaluation of Educational Provisions for Isolated Children Enrolled with the PCS in Queensland.

NEEDS OF LEARNERS	CORRESPONDENCE	SCHOOL OF THE AIR	ITINERANT TEACHING
Academic Skills and Processes	Clearly established capacity to deal effectively with this area	Some capacity to deal with this area in association with PCS papers	Potential to deal with this area during periods of visits. (Visits are short hence capacity is limited)
Social Skills	Some capacity to deal selectively with this area, particularly in written communication form	Considerable capacity to deal with major areas, can be selective and supportive of work done by PCS	Potential to deal with this area during visits
Affective Creative Skills and Experience	Little effort given to addressing this area	Some capacity to contribute. Technology imposes limits.	Potential to deal with this area during visits.

FIGURE 2.2 : Elements of learner needs

Comments regarding the relationship of the PCS, SOTA and Itinerant Teachers with respect to elements of the educational process are given in FIGURE 2.3.

	ORGANIZATION	MOTIVATION	LEARNING PROCESSES	COMMUNICATION PROCESSES	DIDACTIC ACTIVITY	EVALUATION
PCS	very high degree of freedom in when learners engage in learning	very limited in-built capacity for motivation	largely limited to stimulus - response method	Written communication, some oral. Formal, precise. Difficult to modify. Always Student ↔ Teacher	Unable to be modified quickly. Highly refined, very high quality content	Extremely slow feed-back. Evaluation formal
SOTA	Content and timing of learning is beyond the control of the learner. Some degree of flexibility in-built because of frequency of lessons	Considerably greater capacity for motivation. Peer pressure to perform can be high.	Capacity to utilise stimulus, response method, imitation and identification.	Totally oral usually planned with some capacity for informally. Capacity for: teacher student ↔ student	Capacity to be modified quickly - dependent upon teachers experience and confidence.	Immediate feed-back. Evaluation more informal.
ITINERANT TEACHERS	Highly inflexible dependent upon itineraries.	Can be highly effective/ personalised. Frequency of interactions limit effectiveness	Capacity to use all three methods. Suspect imitation identification strong.	Mainly spoken language and non-verbal. Simulated classrooms.	High capacity for modification to meet learner needs.	Immediate feed-back. Evaluation usually informal.

FIGURE 2.3 : Fundamental elements of teaching and learning

The ideal distance education system would have the following characteristics:

1. Social Skills - Capacity to establish learning conditions which promote acquisition of these skills

2. Affective/Creative Skills - Ability to provide meaningful experiences and promote acquisition of skills

3. Academic Skills and Processes - Capacity to deal with this area effectively

5. There should be an in-built capacity for motivation

6. The system should employ a variety of learning processes

7. Communication processes should include a variety of forms

8. Didactic activities and materials should be of high quality but retain a capacity for modification

9. Rapid evaluative feedback is essential. A variety of forms of evaluation is desirable.

10. Maximum opportunities should be provided for direct interaction between teacher and student.

11. There should be a high degree of freedom as to when learners learn. If flexibility is a strength of distance education, this strength should not be unnecessarily reduced.

CHAPTER 3

EXISTING SERVICES IN THE NORTH-WEST REGION

3.1 Educational Resources

The administrative organisation of education within Queensland divides the State into nine Regions. Three regions are in the city of Brisbane and environs. The North-west Region is the relevant region for this study and is illustrated in Figure 3.1.

While the Mount Isa SOTA is the major focus of this study of distance education services within the North-west Region, it is only one of the distance education provisions in the Region. The general distribution of the enrolled students in the Mount Isa SOTA is shown in Figure 3.2 (1983 population).

FIGURE 3.2 : Shaded area indicates distribution of Mount Isa SOTA students in the North-west Region

FIGURE 3.1 : Educational regions in Queensland

While minor variations in the locations of students occur over time, the pattern for the Mount Isa SOTA in 1983 is unlikely to alter sufficiently to cause an impact upon this study.

Not all students of the PCS are enrolled in the SOTAs. For the Mount Isa SOTA coverage area, hinterland enrolments with PCS and SOTA are as follows:

PCS families - 153
Children - 234
SOTA families - 112
SOTA children - 170

Thus, 64 or 27% of the isolated children in the North-west Region are enrolled in the PCS but not in the Mount Isa SOTA.

The organisation of distance education services in the North-west Region is shown in Figure 3.3 as a flow diagram of the main service providers and their locations.

The PCS services are the standardised services outlined in Chapter 2 and are available to all students enrolled with the school.

The major focus of the Mount Isa SOTA is the support of PCS requirements, although additional services and activities are promoted by the school. These include:

(a) Support for Home Tutors

- on-air sessions approximately once per month for problem solving
- Home Tutors Distance Education Seminar held annually in Mount Isa and Longreach (combined with Charleville SOTA)
- Guidance officer consultancy service.

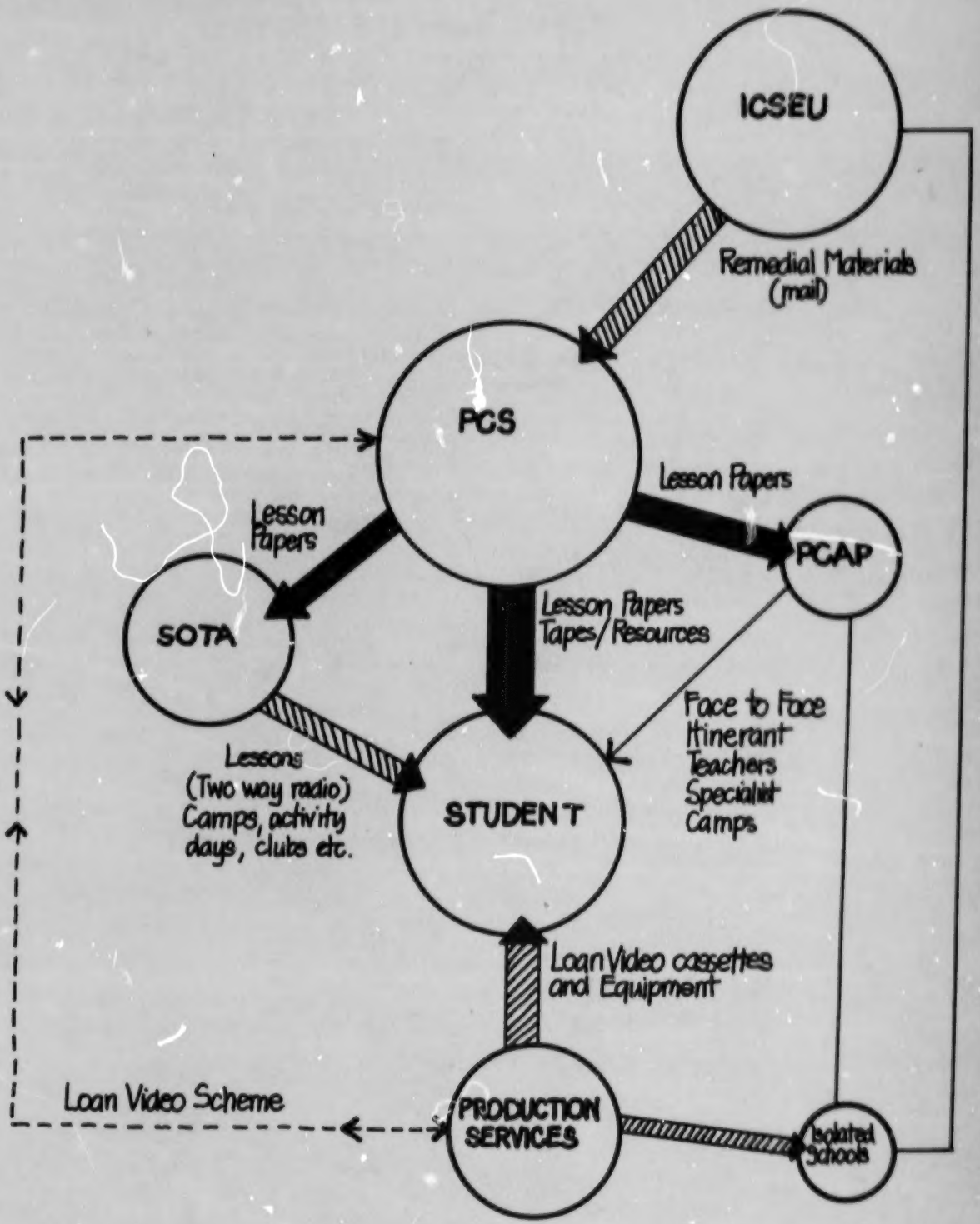


FIGURE 3.3 : Flow of distance education services in North-west Queensland

(b) Support for Students

- Remedial or enrichment session weekly
- Religious Education session weekly
- Recorder session weekly
- Activity groups
- Cubs of the Air, Brownies of the Air
- Guest speakers, Arts Council and entertainers as available.

(c) Activities

- Annual School Camp involving children from Year 4 to 7 conducted at Paluma Environmental Studies Centre (Townsville) or Lake Moondarra (Mount Isa)
- Activity Days conducted at Richmond, Julia Creek, Winton, Camooweal, Boulia, Gregory River, Cloncurry and Mount Isa
- Inter-House Sports Day conducted annually at Mount Isa.

Contact teachers are located at the regular primary schools at Winton and Cloncurry. Itinerant Teachers in the North-west Region operate in teams of two. The ratio of students to teachers is about 30 or 40 for each team. Two Itinerant Teacher teams are located at Mount Isa and at Longreach. A third team is located at Richmond. Teams endeavour to visit all families three times per year and in addition to operate mini schools and camps.

The distribution of Itinerant Teacher and Contact Teacher services in the North-west Region is shown in Figure 3.4.

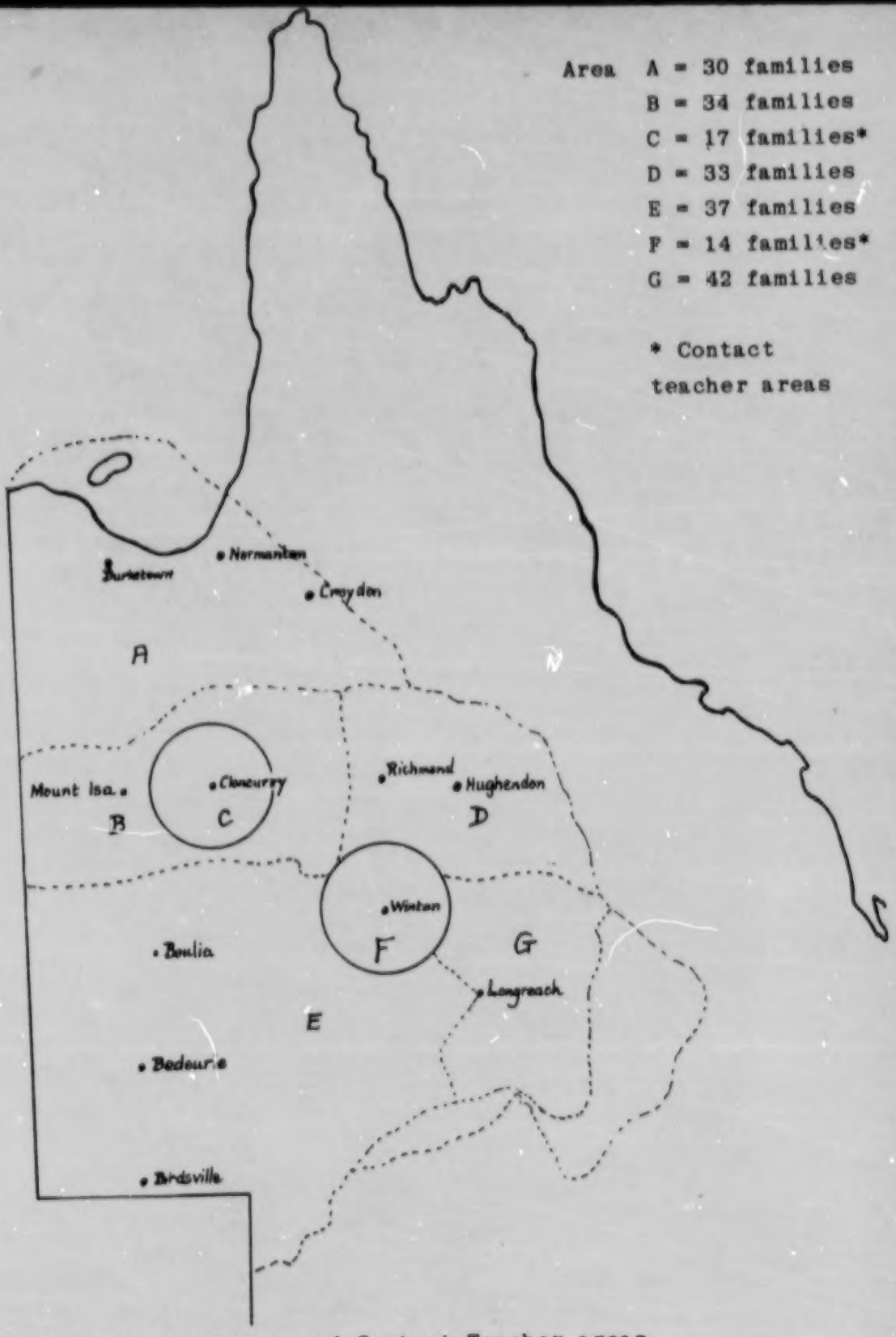


FIGURE 3.4: Itinerant and Contact Teacher areas

3.2 Communications resources

HF radio

The Mount Isa SOTA now uses HF radio exclusively for class sessions, student club activities and for the provision of support to the Home Tutors. Occasionally the telephone is used for contact with the parents or the Home Tutors to resolve specific problems. At Mount Isa, the Royal Flying Doctor Service (RFDS) provides the technical resources to manage the use by the SOTA of three full-time radio channels and a fourth part-time. Students are loaned HF radio transceivers and are assigned to specific frequency channels on the basis or their distance from the SOTA and their requirements for class participation.

The HF radio is used to meet the communications needs of the SOTAs because it is the only medium presently available capable of reaching each of the students. The students' HF radio transceivers are reasonably priced and the use of the ionosphere does not involve a significant cost. Other technologies such as use of VHF radio relays requires the installation of repeaters at intervals of 30 to 40 kms and would be impractical for the large areas covered by the SOTAs. Use of the telephone has also been impractical due to the unavailability of telephone lines to all students, to the party-line nature of some of the services, to the higher priority of other uses of the telephone, and to the telephone charging system which is time and distance dependent.

Although HF radio links are used by all the SOTAs, there are several limiting characteristics:

(a) The links will support only voice type signals;
(b) The teacher-to-student links are fairly clear but those from student-to-teacher tend to be much poorer and require the teacher's close concentration to hear what the students are saying;
(c) The links are subject to fade-outs during some periods of the day and some seasons of the year, and may be interrupted completely for 24-48 hours at a time. Interference can also be sometimes sufficiently severe to disrupt the links.
(d) The scarcity of frequency spectrum makes it difficult to obtain additional radio channel allocations to provide for additional classes.

At the request of the study team, the Mount Isa SOTA teachers made an assessment (based on their past experience) of the quality of the HF radio communications between the SOTA and each of the 180 students enrolled in the School. The results were as follows:

Total Students Enrolled:	180
Total radio sets installed: (93% of enrolled students)	167
Fraction of these students with good communications:	60%
Fraction of these students with fair communications:	29%
Fraction of these students with poor communications:	8%
Fraction not quantified:	3%

The reason for the fair or poor communications for 40% of the students, representing 67 students, is likely to be attributable largely to problems with the installation of the students' sets, the quality of the battery power supplies, contraints in the allocation of an operating frequency, and weak signals at the longer distances. It would be desirable to study the incidence of poor quality communications to ascertain any geographical pattern and to inspect the installations of the students'

transceivers in order to determine whether the performance of these links could be brought up to the standard of the better ones.

The teachers were requested to keep a communications log for the weeks commencing 3 and 9 May 1983 (nine school days). Twenty-one classes, in which a total of 170 students were actively enrolled, were held each day. The teachers were asked to log their assessment and that of the students for each communications link. Over the period, the maximum number of contacts were thus 1530. There were 324 absences from the classes (21%) due either to other commitments or to failure of the communications links. Known failure of the links were recorded separately. For the balance of the 1206 student class sessions, analysis of the logs gave the following results:

QUALITY	TEACHER-TO-STUDENT LINK (%)	STUDENT-TO-TEACHER LINK (%)
Good reception for all the lesson	82.4	67.9
Good reception for at least half the lesson	2.9	2.5
Fair reception for all the lesson	8.7	17.8
Fair reception for at least half the lesson	1.2	2.2
Fair reception for less than half the lesson	0.6	1.0
Poor reception overall	3.0	7.2
Known link failure	1.2	1.4
1206 student class sessions	100 %	100 %

From the analysis, one notes the relatively high "absentee/failed communications" rate of 21%, the confirmation of a higher assessed quality of the teacher-to-student links compared to the student-to-teacher links and the fraction of some 18% to 32% of the links which are rated as being fair or worse leading to an overall assessment that 35% of the total potential contacts being fair or worse. The detailed logs are generally consistent with the teachers' qualitative assessments. The results are also generally consistent with performance achieved on other HF radio links when there is no choice of alternate frequencies. It was noted in reviewing the logs of individual students that there is a consistency in the incidence of good, fair and poor communications.

It must be very difficult to carry out an educational program when voice communications to individual students can be classed as good only some 65% of the time. Good communications to the whole of a class would occur perhaps one time in a hundred. The use of private telephone or satellite links would raise the performance of the links to "good" (equivalent to the best achievable with HF radio) some 99% of the time. Good communications to the whole of a class would then occur some 90 times out of 100.

Rural telephony

The telephone has not been used to any great extent for SOTA or other distance education purposes in the Mount Isa area principally because many of the students do not have a suitable or reliable telephone service and because use of HF radio links is much cheaper.

Telecom Australia is continuing to upgrade the telephone service to rural subscribers to increase its quality and reliability. The present rural telephone service consists of a mixture of Telecom Australia and part privately erected lines providing either a private or party-line service; the latter typically shared amongst some 2 to 12 subscribers. In many cases, rural telephone calls are handled through an operator. Many of the privately erected lines have not been installed to Telecom

standards and have an earth return circuit of highly variable performance. The Telecom lines to which they are interconnected tend to cause failures along with the equipment at some manual exchanges. Due to these factors, the rural telephone service has been regarded as unreliable and somewhat sub-standard.

To gain an appreciation of the quality of the rural telephone service, a small number of people were called at random in May-June 1983. All the calls were successfully placed on the first try and the quality was fair to good. All persons contacted noted difficulties in maintaining a service and some incidence of outages, but regarded the telephone service as being better and somewhat more reliable than HF radio. However it was clear that shared party-line telephone service precludes use of the telephone for education. Such use would either tie up the line for too long or conflict with the requirements of other subscribers.

The future availability of the ACSS as well as the planned upgrading of the rural telephone system will improve the type and quality of communications available in rural and remote regions of Australia. This leads to consideration of how the improved communications can be used for distance education services.

3.3 Assessment of North-west Services

Existing services in the North-west region exhibit both strengths and weaknesses. Clearly the current arrangement has the advantage of allowing for a choice in the mix of services. Thus, the capacity of the totality of services to harmonise with a variety of lifestyles is increased. Among the most significant and advantageous features is the overall support for Home Tutors possible through interaction with a number of different teachers. Strengths, however, can be also weaknesses.

Clearly a student could become confused in dealing with the number of different types of teachers:

- a PCS teacher
- a SOTA teacher
- an Itinerant Teacher or a Contact Teacher
- an ICSEU teacher
- a specialist Art/Music teacher
- a Home Tutor who, in most cases, is also mother.

It is significant that none of the above teachers ever develops a complete profile of the student. Fundamental relationships between teachers and parents in areas of communication and co-operation are not satisfactorily developed. Relationships between student and teacher based on the recognition and valuing of a diversity of skills, talents and contributions may not be possible.

As previously indicated, the PCS is the prime Department of Education agency for the provision of distance education services. An examination of the PCS papers indicates an emphasis on knowledge and skills rather than attitudes and understandings in its curriculum interpretation. While the medium of communication employed by the PCS accounts for this emphasis, the need exists to balance the emphasis in some way and the lack of balance can only be regarded as a disadvantage.

The capacity of existing services in the North-west Region to meet the needs of students and to incude the fundamental elements of teaching and learning are analysed in Figure 3.5. The assessment criteria used are those developed in section 2.4 of this Report.

Two opposing lines of thought exist with respect to the application of satellite communication to distance education in Queensland. The first proposes that distance education services should be centralised in Brisbane to maximise the resources available. The second proposes a greater degree of regionalisation of distance education services.
Both arguments are treated in this Report in Chapters 4 and 5 which follow.

	ABILITY TO CATER FOR										
	Social Skills	Affective Creative Skills	Academic Skills	Organisation of Learning	Motivation	Learning Processes	Communication Processes	Didactic Activity/Materials	Evaluation	Frequency of Interaction	Harmony with Lifestyle
CORRESPONDENCE EDUCATION	0	0	●	●	X	X	0	X	0	X	●
SCHOOL OF THE AIR	●	+	X	+	●	+	+	+	●	+	+
ITINERANT TEACHER SERVICE	X	X	X	X	+	●	●	●	●	X	+

LEGEND

High	-	●
Medium	-	+
Low	-	X
Nil	-	0

FIGURE 3.5 : Assessment of existing North-west Region services

CHAPTER 4

SERVICE IMPROVEMENT THROUGH STRENGTHENED CENTRALISM

4.1 Administrative Structure

Factors which support the argument for strengthened centralism are:

(a) major components of the distance education service (PCS, ICSEU) are already located in Brisbane;

(b) other major agencies which operate a support role to the correspondence school are also located in Brisbane - including the Australian Broadcasting Corporation (schools broadcasting services, radio and television), Production Services Branch, Library and Resource Services and Curriculum Branch;

(c) numerous system-level agencies and services which can impact on distance education are also located in Brisbane (e.g. Reading Development Centre, In-service Education Section, Research Branch, Planning Branch);

(d) AUSSAT Pty Ltd has a commitment to the establishment of a Major City Earth Station in Brisbane which may obviate the need for the Department of Education to establish uplink facilities.

The current range of technology available to the PCS limits its operation, its range of services and the quality of education provided. Satellite technology will enable an expansion in the variety of services available, the quality of the programs offered and an increased speed of reaction to student needs.

With satellite services, the vast majority of PCS students could be provided with a program which mixes correspondence papers, audiotapes and other resources such as interactive audio in a manner similar to the existing SOTAs. The possibility exists also for television broadcasting of lessons to students, delivery of video resources to students, and television and audio materials for Home Tutors. With the expanded range of communications available, a broadening of the curriculum offerings of the PCS might be expected.

Staff of the PCS are acutely aware of the need to provide feedback to students and Home Tutors as quickly as possible. The availability of satellite technology would allow this process to be accelerated so that feedback on completed correspondence papers could be provided within days of being received by PCS teachers.

Services which could be made available through a strengthened and centralised PCS include:

(a) Correspondence papers: It is envisaged that the provision of correspondence papers will always be maintained as a major component of the distance education service.

In many instances, papers are the best way of transmitting information to learners and this facility should always be available. The nature of papers may change in an evolutionary way as appropriate elements of the service are handled by alternative media.

(b) Interactive Audio: The service currently provided through SOTA could be provided from the Centralised Correspondence School. Daily on-air satellite programs for class groups might be provided by teachers of the Centralised Correspondence School to give students immediate feedback on their papers. Additional sessions could be conducted for Home Tutors.

(c) Direct Broadcast Television: A consistent request from Home Tutors for the provision of examples of how to teach particularly difficult topics could be met with the broadcast television capacity of satellite communications. Students would also receive benefit from satellite-delivered educational television broadcasts concerning particularly difficult topics.

These educational television programs would continue and enhance the work commenced by the Loan Video Scheme. The Loan Video Scheme is currently restricted to one hour of material per fortnight per age grouping. A satellite educational television facility might be able to increase the amount of time available to each age group.

The flow of educational materials under strengthened centralism is shown in FIGURE 4.1.

4.2 Technical Factors

The ACSS could support the provision of voice communications between the teachers and the students through the shared use of a 12 watt satellite transponder operating in either a national or a zonal beam. Technically, it would also be possible to provide educational television through the 30 watt transponders which are intended principally for use by the Homestead and Community Broadcasting Satellite Service (HACBSS).

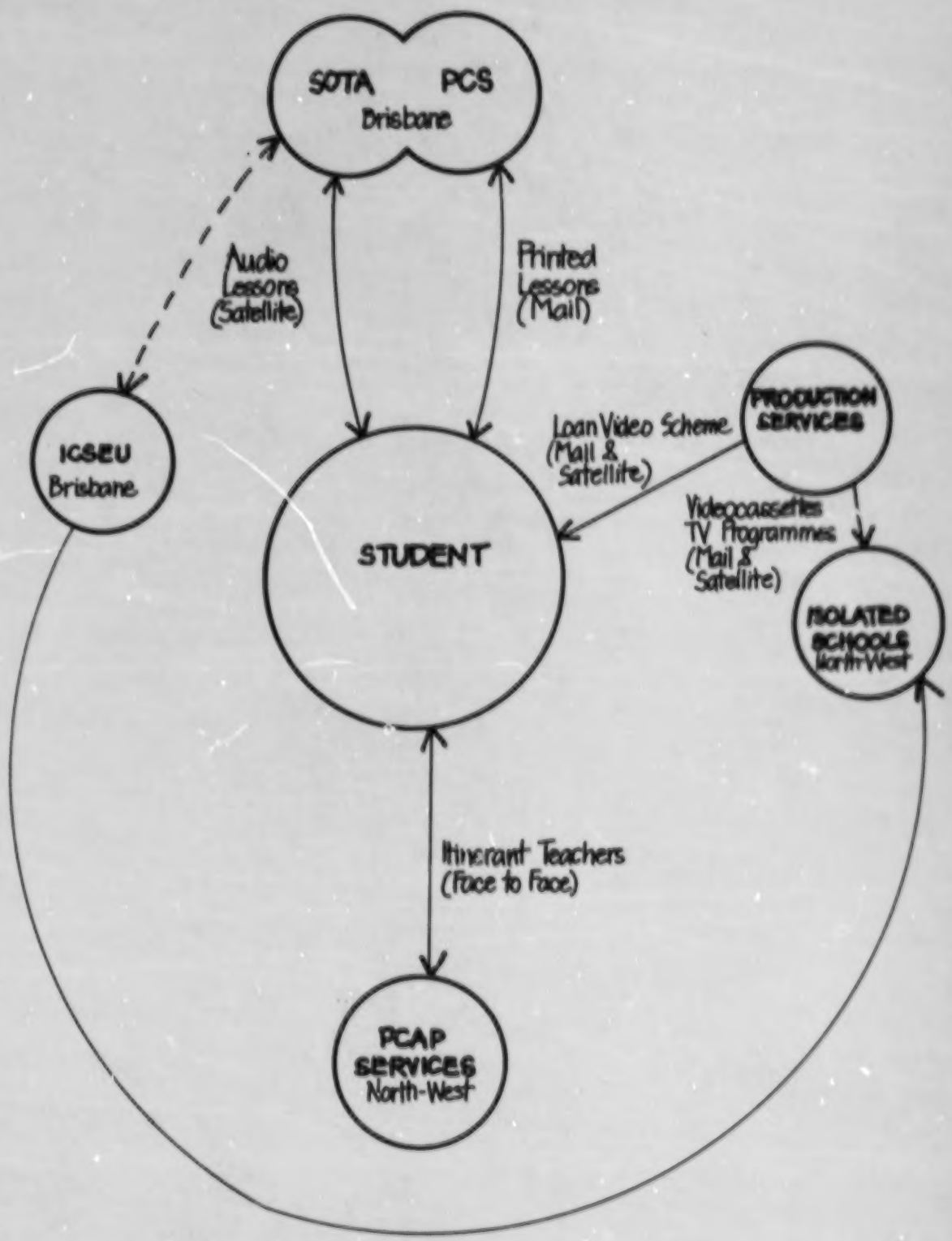


FIGURE 4.1 : Strengthened Centralism

The communications services to support the centralised system are illustrated in Figure 4.2. All Queensland SOTA classes would be uplinked from Brisbane. Students would be divided into classes in an organised fashion, not necessarily on the basis of geographical proximity. Since all of Queensland would be the school, there would be considerable flexibility in assignment of teachers and students to communications channels and some flexibility to change assignments on short notice.

Many students would be equipped with 1.8 metre to 2.5 metre transmit/receive earth stations to receive the teachers signals and to respond. Some students because of family mobility or the limited duration of their enrolment in the SOTA might be precluded from the allocation of expensive transmit/receive earth stations. Such students would participate in the SOTA classes through use of the telephone. Should it be desirable for these students to listen in on some class sessions without participating, or to reduce the active telephone time and hence the time dependent cost, they could be provided with a cheaper and more transportable receive-only earth station.

The use of HF radio for student responses would not be feasible because of the difficult propagation and interference problems associated with the longer distance paths between individual students and Brisbane. It can be recalled that centralisation of the SOTAs at Brisbane is not feasible at present due to these HF radio problems.

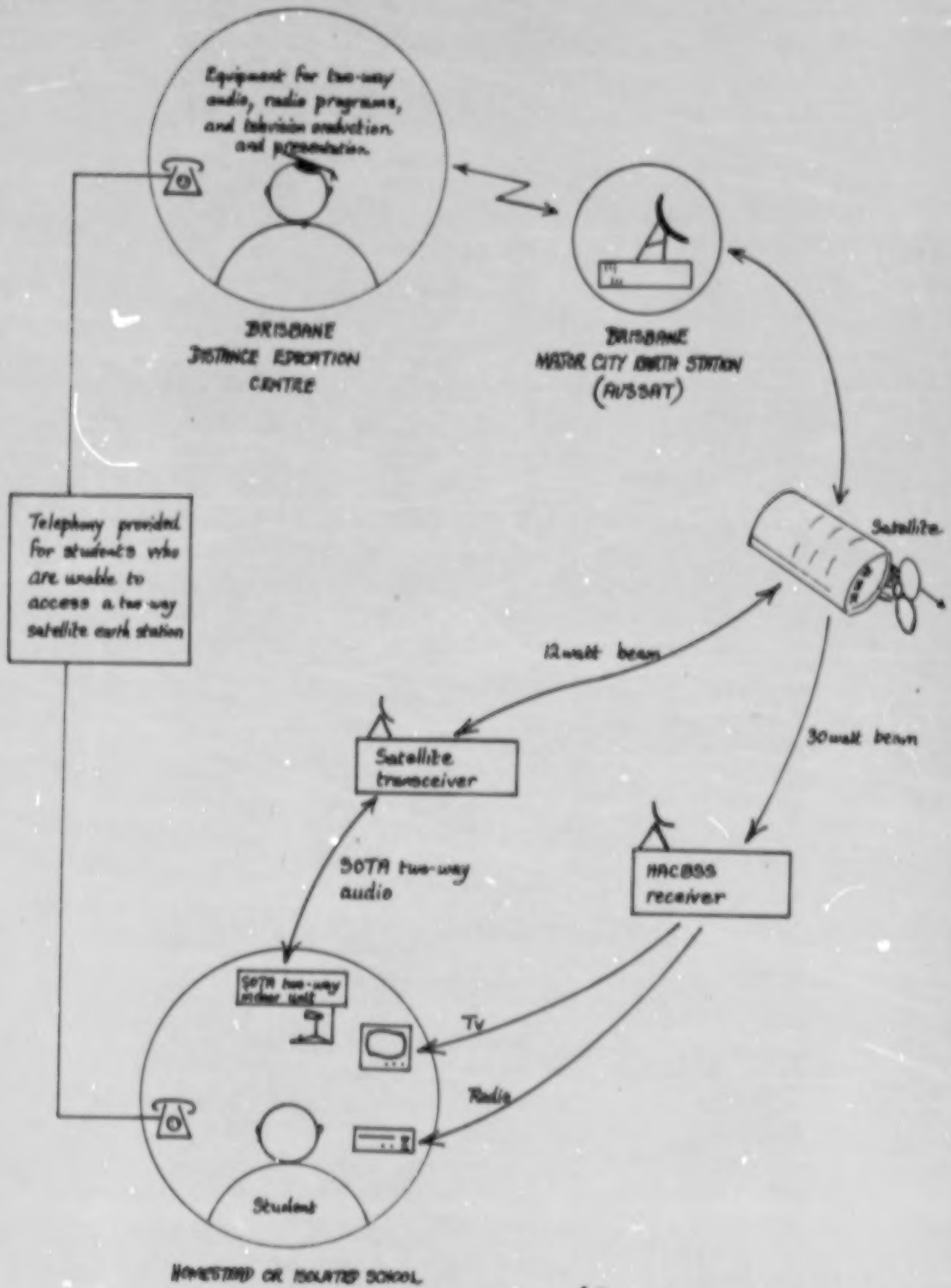


FIGURE 4.2 Communications links for centralised distance education

The communications for the centralised system would therefore depend primarily upon the use of the ACSS and to some extent upon the use of the telephone. There would be little scope for gradually phasing in the revised system. Continued use of HF radio would require the building of an expensive HF radio base station near Brisbane but the resultant service would be poorer than that existing now simply because student transceivers would not be able to send a strong enough signal all the way to Brisbane. Remote connections via terrestrial links from Brisbane to the RFDS transmitter sites would be expensive and prone to technical failure. The present party-line telephone service would not be adequate for SOTA and it might be several years before private line telephones would be accessable by isolated students.

The conclusion to be drawn from the foregoing factors is that it is not feasible technically, financially or administratively to implement the centralised system in the 1980s. This is due to the current nature of the remote telephone service, the characteristics of the HF radio channels, the high total cost of procurring large numbers of transmit earth stations and the need to be cautious in centralising a service using an improved technology.

If use of the ACSS were introduced into the present SOTAs, it would be possible to make a transition to a centralised system in the 1990s when the use of satellite and telephone links were fully proven and a major investment had been made to provide transmit/receive earth stations. Only when the satellite and private line telephones were fully in place, would it be possible to abandon use of the HF radios and shift the location of the SOTA teachers to Brisbane.

4.3 Assessment of Strengthened Centralism

Since the early 1970s there has been a strong movement towards the decentralisation of educational decision making in Queensland. Any system which attempts to reimpose a high degree of centralised control risks raising significant antagonisms among teachers, parents and even students.

Rural areas of Queensland have developed a heightened awareness of the need for an increase in the quality and breadth of curriculum offerings which maintain relevance with local needs. Strong educational argument is likely to come from rural areas against any move towards centralisation.

The need for close communication and co-operation between teacher and parent is particularly crucial for the success of distance education at the primary level. The capacity for teachers and parents to develop meaningful relationships is extremely poor while they are separated by extremes of distance. The teacher's understanding of the home, its environment and sub-culture will be somewhat tenuous under such circumstances.

The harmonisation of distance education services with the lifestyles of student families becomes even more crucial under a centralised scheme. Interactions between teacher and student would be almost exclusively confined to formal channels e.g. post, telephone, satellite services. The likelihood of meetings between students and teachers would be rare.

A centralised service organised to cater for all students enroled in the PCS would place substantial constraints upon the lifestyles of families. Under the present circumstances, freedom of action by families is constrained only to the extent that children need to participate in a 30 minute SOTA lesson daily. SOTA transceivers are relatively mobile so that scheduling of lessons with competing functions (mustering for example) is possible. The capacity to accommodate the variety of Brisbane-based services will be considerably reduced.

Strengthened centralism does not necessarily mean the cessation of field services to distant learners. Thus, Itinerant Teachers, mini schools and activity days etc., will presumbably continue. However, it is difficult to envisage appropriate consultation, support and management being supplied from Brisbane.

The assessment of strengthened centralism given in Figure 4.3 draws upon the assessment criteria developed in section 2.4 of this Report.

	CAPACITY TO CATER FOR											
	Social Skills	Affective Creative Skills	Academic Skills	Organisation of Learning	Motivation	Learning Processes	Communication Processes	Didactic Activity/Materials	Evaluation	Frequency of Interaction	Harmony with Lifestyle
CENTRALISED CORRESPONDENCE SCHOOL	●	◆	●	■	◆	◆	■	■	◆	◆	■

LEGEND

High	-	●
Medium	-	◆
Low	-	■
Nil	-	○

FIGURE 4.3 : Assessment of strengthened centralise

CHAPTER 5

SERVICE IMPROVEMENT THROUGH STRENGTHENED REGIONALISM

5.1 Administrative Stucture

The concept of regionalism used in this chapter concerns a functional reorganisation of those educational services currently provided in the North-west Region. It is envisaged that students would continue to interact through Correspondence papers, SOTA lessons, activity days, and mini schools and through contact with Itinerant Teachers. A change to strengthened regionalism would simply mean that the provision of educational services to isolated students in the North-west would be functionally coordinated through Schools of Distance Education.

The existence of Schools of Distance Education might be brought about by making the following changes:

(a) The existing PCS becomes a Distance Education Materials Development Centre.

A variety of materials development models are available which would be suited to the proposed relationship between the Distance Education Materials Development Centre and Schools of Distance Education. There are significant advantages, both educationally and economically, in having the basic learning materials developed centrally. Issues such as acquired expertise, economies of scale, singularity of purpose, capacity for rapid review and modification are among the arguments in support of this stance.

(b) The existing activities of the SOTAs, Correspondence paper correction, Itinerant Teacher service and ICSEU referral become the focus for the Schools of Distance Education.

The Schools of Distance Education would have the capacity to adapt the basic materials developed centrally to increase the specificity of the materials to the learning needs of individual regional students.

By co-ordinating Correspondence papers, on-air lessons, visits by Itinerant Teachers and other activities, the Schools of Distance Education would assume a greater responsibility for the teaching element in distance education.

A School of Distance Education could be created in one of two ways:

(a) by establishing such a school as an autonomous institution - perhaps an existing SOTA;

(b) by establishing the 'distance' school as part of an existing traditional school with the 'distance' and 'traditional' components having equal status.

The characterisitcs of an autonomous School of Distance Education would appear to be:

- clarity of purpose;
- high status;
- unique organisational structure;
- opportunity to establish its own reputation;
- a clear understanding on the part of teachers of what is expected of them.

Many of these characterisitcs are already discernible in the operation of SOTAs as a response to unique situation of the distance learner. Such characteristics should not be dispensed with lightly. Educators have long recognised the positive benefits of a strong relationship between community and school, and there can be no doubt that such a relationship exists with respect to SOTAs.

Of the characteristics listed, the uniqueness of organistional structure should be examined in some detail. The possibility of a principal of such a school might be explored bearing in mind the particular characteristics of school and distance education services.

A School of Distance Education attached to a regular school offers certain advantages in terms of resources and professional interaction. However, it will place unique demands on all who would participate in it.

Services which could be made available through a School of Distance Education include:

(a) Co-ordination of existing services.

The function of a School of Distance Education is seen as co-ordinating the provision of services to distance learners. A fundamental element in this activity is the capacity to aggregate information about the learner and the dynamics of the learning process in which he/she is participating.

Thus the elements of Correspondence papers, SOTA lessons and resources need to be managed in a teaching process; itinerant teacher services, mini schools and activities need to be integrated in a purposeful manner as part of an overall curriculum program.

One particular issue which needs attention is that of the marking of Correspondence papers. While considerable community support exists for papers to be marked at the SOTA, there may be a variety of alternative actions possible which take account of mail services, a restructured Correspondence service and new initiatives. This issue would benefit from detailed examination.

(b) Accessibility to existing resources and facilities.

Under the existing arrangements, SOTAs and the PCS are regarded more as regular schools than points from which educational services are transmitted to a special group of learners.

One of the effects of this approach has been that facilities, resources and the possibility of services of local regular schools are not easily accessible to the distance learner.

The establishment of a School of Distance Education should facilitate access to resources and facilities as well as provide additional locally-based services.

The strengthened regionalism approach is shown in FIGURE 5.1. This is a flow diagram outlining the main service providers and their locations as they relate to North-west Region education services for isolated students. A separation is made in the diagram between students having complete two-way satellite communications at their homestead and those students who rely on telephony or HF radio for talkback.

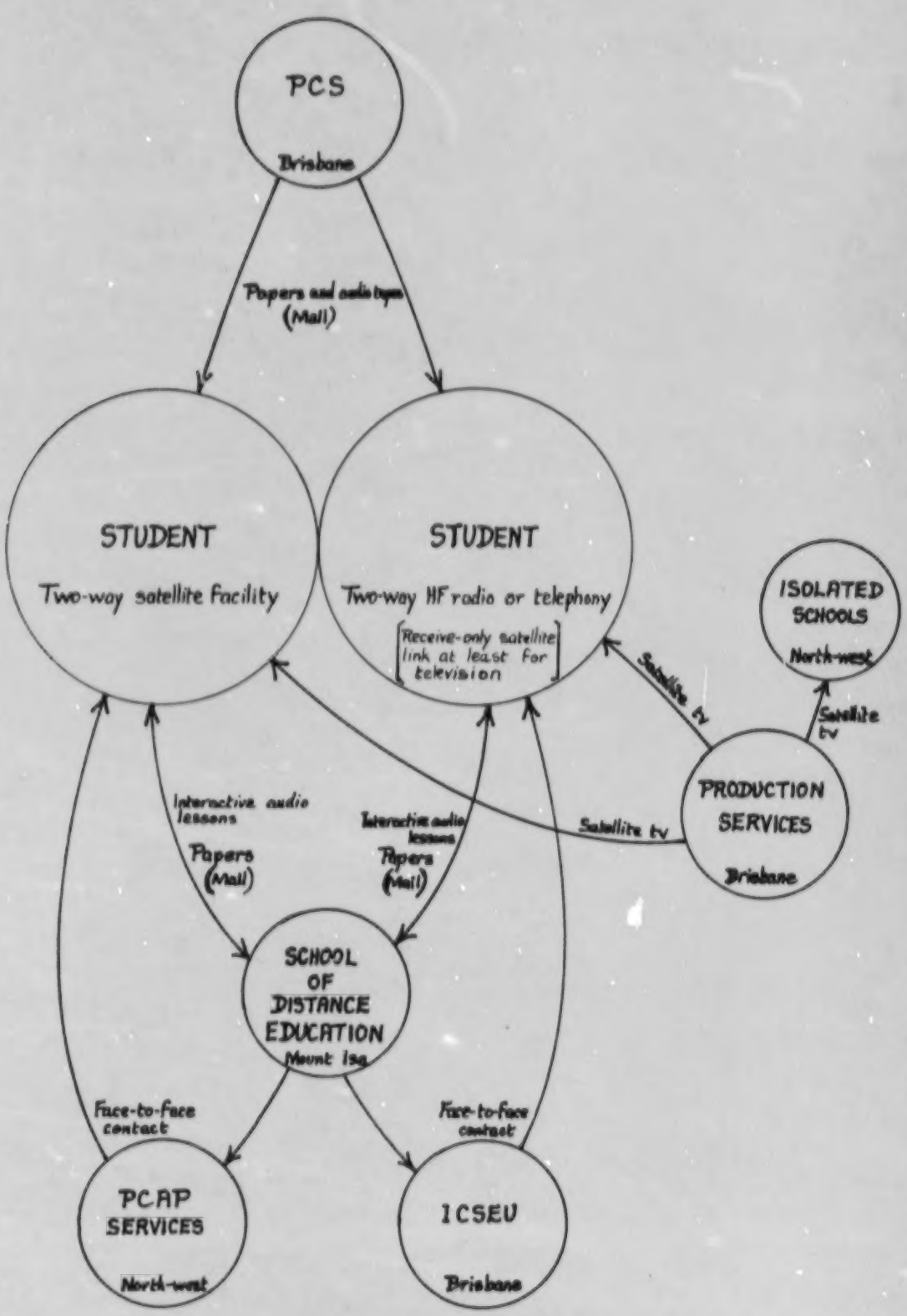


FIGURE 5·1 Strengthened regionalism

5.2 Technical Factors

The introduction of the ACSS can overcome many of the communication problems inherent in the use of HF radio. Appendix A discusses the capability of the ACSS to support SOTA classes as well as to provide communications for the distribution of educational television and other distance education services. The use of satellite links in a strengthened regionalism system is illustrated in Figure 5.2.

The Mount Isa SOTA (or School of Distance Education) could be equipped with an uplink/downlink earth station capable of carrying the number of voice signals required to support the simultaneous classes conducted by the school. Students participating in this two-way satellite communications facility would need transmit/receive earth stations with antennas between 1.8 and 2.5 metres in diameter.

Those students who for various reasons could not be allocated a two-way earth station might participate through the existing HF radio network or a suitable telephony service. Students using these media might have the option of being allocated a less expensive receive-only earth station so that they could at least receive the teachers' transmissions clearly. The reliable teacher-to-student links thus provided could then also be used for text and data transmission for enhanced education services to the extent that these were educationally desirable and economically feasible.

Classes conducted with students using a mix of satellite, telephony and HF radio for the student-to-teacher links would have their transmissions interconnected at the teacher's console and be rebroadcast at the teacher's discretion.

The introduction of improved communications links in a strengthened regionalism system could be evolutionary starting from the present HF radio networks. There would be no need for a sudden and irreversible introduction of a changed transmission technology. Transmit/receive earth stations could be introduced

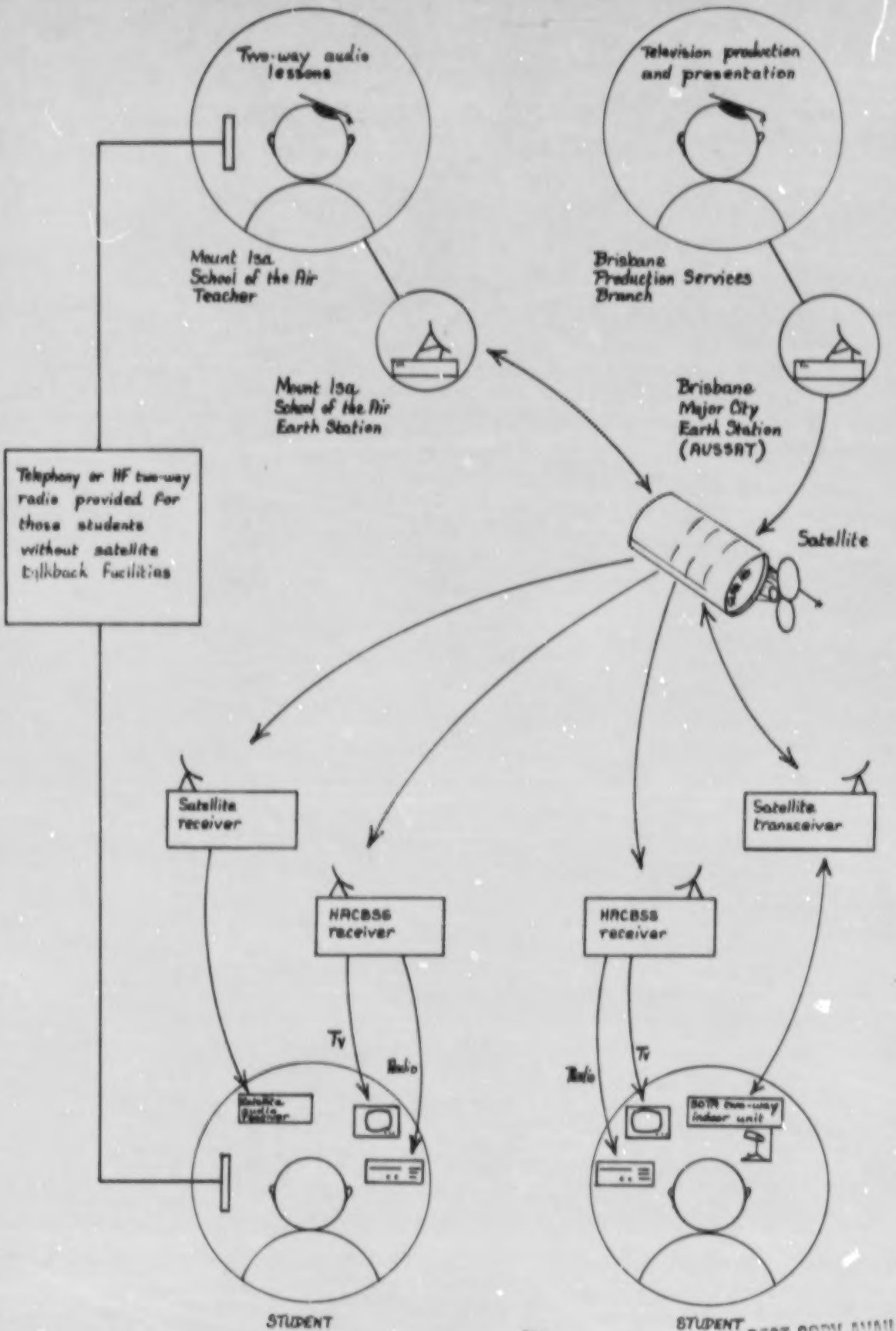


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FIGURE 5.2 Communications links for regionalised distance education

in varying numbers over a period of years. Maybe a larger number of receive-only earth stations could be introduced each year in a balanced and complementary implementation to that planned for the transmit/receive earth stations. Students who were not allocated a transmit/receive earth station would continue to use the HF radio transceivers to reply during classes or use a private telephone line. These latter students might become more numerous as Telecom Australia implements service improvements.

A gradual phasing-in of improved communications in a strengthened regionalism system is feasible; the rate of introduction being dependent upon the funding available each year for the perceived improvement in education. The phasing-in could be part of a trial system which began by parelleling the HF radio network and then gradually replaced it for all the teacher-to-student links and for a major portion of the student-to-teacher links.

5.3 Assessment of Strengthened Regionalism

The assessment given in Figure 5.3 of the strengthened regionalism approach to the delivery of educational services to North-west Region isolated learners upon the assessment criteria developed in section 2.4 of this Report.

Strengthened regionalism serves the educational needs of the North-west Region in a flexible manner allowing for change, increase in usage and, most importantly, control to be maintained by teachers located close to their students. The technological support available from communications satellites is well suited to the educational requirements envisaged for increasing the quality of existing services.

Improvements in the quality of educational services would come through the reorganisation and altered coordination of existing services. The whole concept of strengthened regionalism is one of a functional reorganisation rather than specific changes in the services provided.

	CAPACITY TO CATER FOR										
	Social Skills	Affective Creative Skills	Academic Skills	Organisation of Learning	Motivation	Learning Processes	Communication Processes	Didactic Activity/Materials	Evaluation	Frequency of Interaction	Harmony with lifestyle
SCHOOL OF DISTANCE EDUCATION	●	+	●	●	+	●	●	+	+	+	+

LEGEND

High	-	●
Medium	-	+
Low	-	x
Nil	-	0

FIGURE 5.3 : Assessment of strengthened regionalism

CHAPTER 6

PREFERRED SCENARIO

6.1 Educational Requirements

There are some basic characterisitcs of distance educaticn which the study team developed in Chapter 2 of this Report to guide in the assessment of alternative scenarios. These characteristics, simply stated, are an ability to cater for:

a) Social skills;
b) Affective creative skills;
c) Organisation of learning;
d) Motivation;
e) Variety of learning processes;
f) Various communiation processes;
g) Didactic activity/materials;
h) Evaluation;
i) Frequency of interaction;
j) Harmony with lifestyle.

Three models have been evaluated in this Report: the existing arrangement (Chapter 3), strengthened centralism (Chapter 4), and strengthened regionalism (Chapter 5). The above desirable characteristics were evaluated against each model and the result is summarised in Figure 6.1. There is a clear indication from the summary that a change towards strengthened regionalism would yield an improvement in educational services for isolated learners. The reasons for this are based on increasing the quality of service, increasing and enhancing the variety of services, and the way in which new technology could be introduced in an evolutionary manner to achieve the desired results.

The study team, thus, prefers the strengthened regionalism scenario as the one most likely to bring improvement to North-west Region distance education.

	CAPACITY TO CATER FOR										
	Social Skills	Affective Creative Skills	Academic Skills	Organisation of Learning	Motivation	Learning Processes	Communication Processes	Didactic Activity/Materials	Evaluation	Frequency of interaction	Harmony with Lifestyle
Existing Services aggregated	◆	x	◆	◆	◆	◆	◆	◆	●	x	◆
Strengthened Centralism	●	◆	●	x	◆	◆	x	x	◆	◆	x
Strengthened Regionalism	●	◆	●	●	◆	●	●	◆	◆	◆	◆

LEGEND

High - ●
Medium - ◆
Low - x
Nil - 0

FIGURE 6.1 : Evaluation of the distance education scenarios

In expressing this preference, cognizance has been taken of the available technologies and their relevance to the educational objectives of distance education. Satellite communications could be used in both centralised and regionalised systems but, on balance, the study team has found that maximum benefit would be achieved under the strengthened regionalism approach.

Satellite technology offers considerable advantages over the existing HF radio system. These advantages have been explored in preceeding Chapters and more fully in Appendix A. Some advantages would be achieved by simply replacing HF radio with satellite communications. There is, however, a number of ways to enrich and enhance existing educational services which could only be achieved by making complementary adjustments in the services themselves to take full advantage of the opportunities offered by the new technology.

Strengthened regionalism achieved through the introduction of satellite communications does allow for an evolutionary approach. Parallel operation of HF radio and satellite links would not be difficult and would allow a period of years to elapse while students were equipped with satellite earth stations.

Parallel operation could begin in a pilot mode and, without prejudice to the students' education, could be terminated should the satellite experiment prove unsuccessful after an evaluative period. In any case, HF radio is likely to linger for many years because there are students whose high mobility would require the continuing use of HF radio.

6.2 Technical Implementation

The technical implementation of the preferred scenario should be balanced against the relative cost trade-offs between satellite capacity and terrestrial earth station hardware. A prime objective in this balance is to keep the cost of student earth stations to a realistically low value.

The preferred scenario envisages that the audio signals from the teachers will be carried by the satellite on a 12 watt national beam to student receive-only earth stations of at least 1.5 metre diameter or to two-way earth stations of 1.8 to 2.5 metre diameter. Responses from the students will be carried by the satellite, by telephone or by HF radio depending upon the situation of the student and the availability of equipment.

The communications flow for a SOTA class is illustrated in Figure 6.2. The teacher's voice or data could be transmitted to all students through the satellite link. The signals from the students would be mixed at the teacher's console and transmitted back to all other students at the teacher's discretion.

Correspondence School teachers in Brisbane could listen to SOTA classes by means of a receive-only earth station. If they wished to participate in a class, they could use the major city earth station or a student type two-way transmit/receive earth station and join the class through connection at the SOTA teacher's console.

Educational television might be used to augment the audio services by using either a 12 watt or a 30 watt transponder.

A television signal would occupy all the capacity of a 12 watt transponder. As such, this type of educational television programming could only be conducted at night times or weekends when the audio services were not required. Also, because of the lower power, the television signals could only be received by larger earth stations which might be suitable for use only at schools.

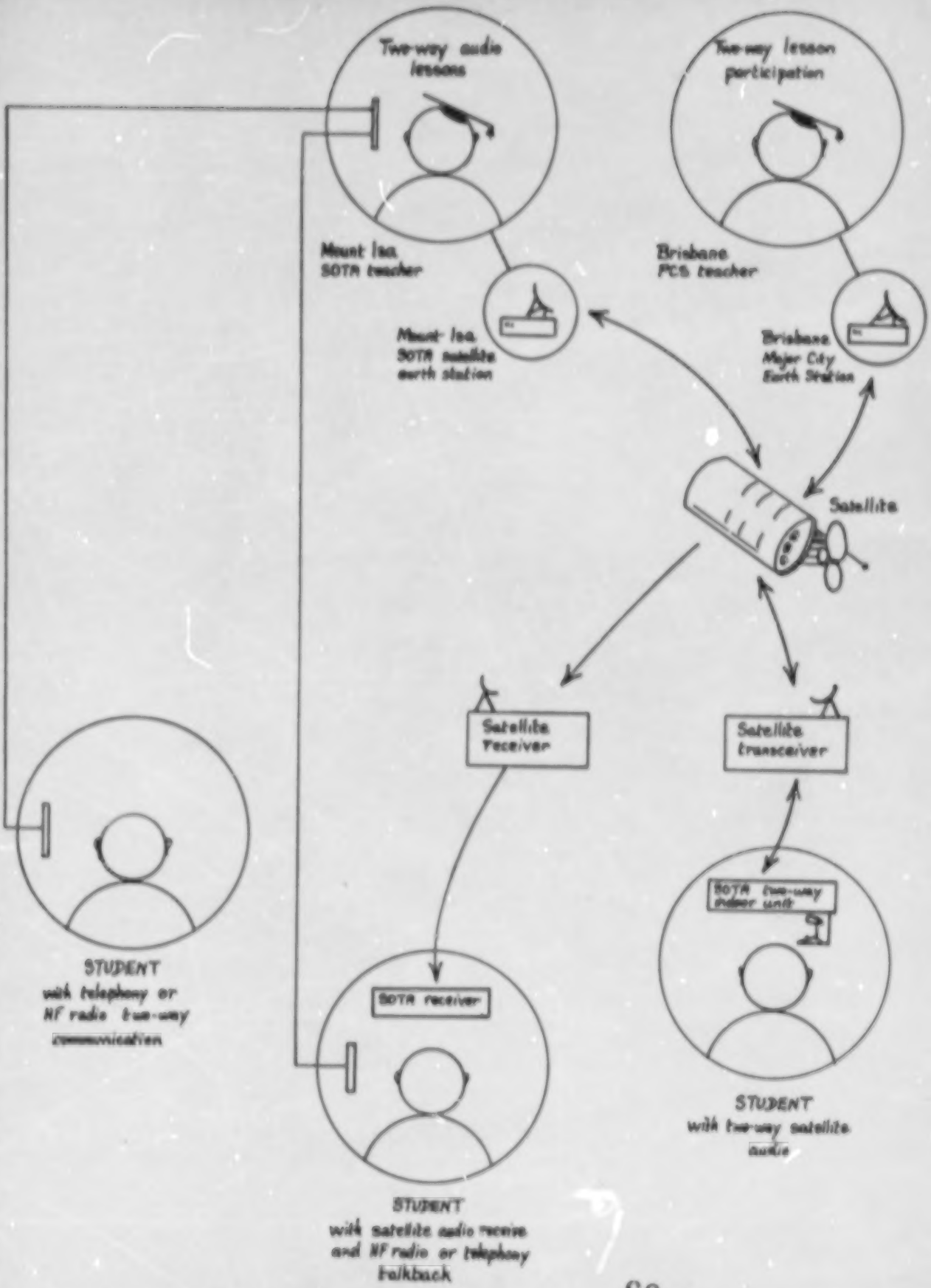

Two-way audio lessons
Mount Isa SOTA teacher
Two-way lesson participation
Brisbane PCS teacher
Mount Isa SOTA satellite earth station
Brisbane Major City Earth Station
Satellite
Satellite receiver
Satellite transceiver
SOTA receiver
SOTA two-way outdoor unit
STUDENT with telephony or HF radio two-way communication
STUDENT with satellite audio receive and HF radio or telephony talkback
STUDENT with two-way satellite audio

FIGURE 62 Communications Flow at Mount Isa SOTA

An Australian-built 2.4 metre earth station at the Department of Communications test site at Alice Springs

As an alternative, the educational television programming might be carried on the 30 watt transponders either as part of the HACBSS or as an independently negotiated service. Such use, however, would be subject to Government decisions concerning the use of the 30 watt transponders. These signals could be received using the 1.5 metre HACBSS receivers.

Whatever option for educational television was chosen, it is expected that the programming would have to originate in Brisbane because of the technical complexities. Some form of student interaction with the television programming could be arranged using the audio network established for SOTA or with telephone links.

It is technically quite feasible to provide facilities to meet the communications requirements for improved Mount Isa SOTA and other distance education services. Furthermore, the introduction, based on strengthened regionalism, can be evolutionary building upon the infrastructure already in place for the SOTA, the Loan Video Program and the PCS. Satellite links and the telephone would gradually replace HF radio for much of the STOA but a residual HF radio service would need to be retained for communication from itinerant students.

A balance would be found between use of private line telephones and student transmit/receiver earth stations. Satellite links could replace mail delivery for television tapes.

To develop the concept of the use of the ACSS further, we need to examine the options for the use of the 12 watt transponder.

Options for Use of a 12 Watt Transponder

A 12 watt transponder connected into a national beam could be shared among the State Departents of Education with the States sharing the lease cost.

Using the national beam, some 12 to 35 teacher-to-student channels receivable by 1.5 metre receive-only earth stations can be accommodated. The lower number of channels would be provided with links having the quality of AM radio programs. The higher number of channels would be provided with links having the quality of the telephone. For all the present 12 SOTAs, the total requirement is for 18 teacher-to-student channels. However, some States may not wish to use satellite links or may delay the introduction of the services and so reduce the channel requirement. Alternatively, more channels could be provided through the use of 1.8 metre or 2.5 metre instead of 1.5 metre receiving earth stations. Some operational experience will be required to determine the number of links that will be required and the most economical implementation (i.e. numbers of channels and site of earth stations). Should the requirement for channels exceed the capacity of a single transponder, partial use of an additional transponder could be sought.

All SOTAs would require use of the transponder largely during the period 0830-1700 on weekdays and perhaps to some extent on weekends. The balance of the time could be allocated for educational television. Figure 6.3 illustrates an indicative schedule for transponder use. The time between 0830 and 1900 hours eastern standard time is scheduled for the use of all SOTAs, meeting the requirement for a start at 0830 eastern time in the east running through to the completion of classes at 1600 hours western time (1900 hours eastern time, when the time difference is greatest).

From 1900 hours through 2400 hours the whole transponder could be time-shared for delivery of one educational television channel programmed in time-sequence by each participating State. The programs would be distributed to earth stations with quite large antennas of 3.0 metre to 5.2 metre diameter (the larger diameter would be required at the edge of the satellite coverage beam area). There would be sufficient transponder capacity to accommodate a satellite voice response channel. The use of the transponder for television would have to be time-shared among the State Departments of Education with uplinks from the respective State Major City Earth Stations. From 0000 hours to 0830 eastern standard time the transponder could be time-shared to provide for the distribution of television programs to video recorders for later use. Taking all participating States together, there would probably be the requirement and capability to generate sufficient television programs.

Alternatively the 12 watt transponder could be connected into the NE zonal beam. With the higher-powered zonal beam, 30 to 140 voice channels could be provided to 1.5m receive-only earth stations and more channels if 1.8m or 2.5m earth stations were used. Figure 6.4 illustrates a scheduling arrangement for the use of a 12 watt transponder in the North-eastern zonal beam. In this case, however, rather than being shared among the States, the whole cost of the lease of the transponder would have to be paid by Queensland. The available capacity is much greater than the 9 channels now required for the three SOTAs in Queensland. A large number of channels are therefore available for use by other organisations in the State should the Department of Education wish to reduce its cost by sharing the use of the transponder.

INDICATIVE 12-WATT TRANSPONDER USES
(NATIONAL BEAM)

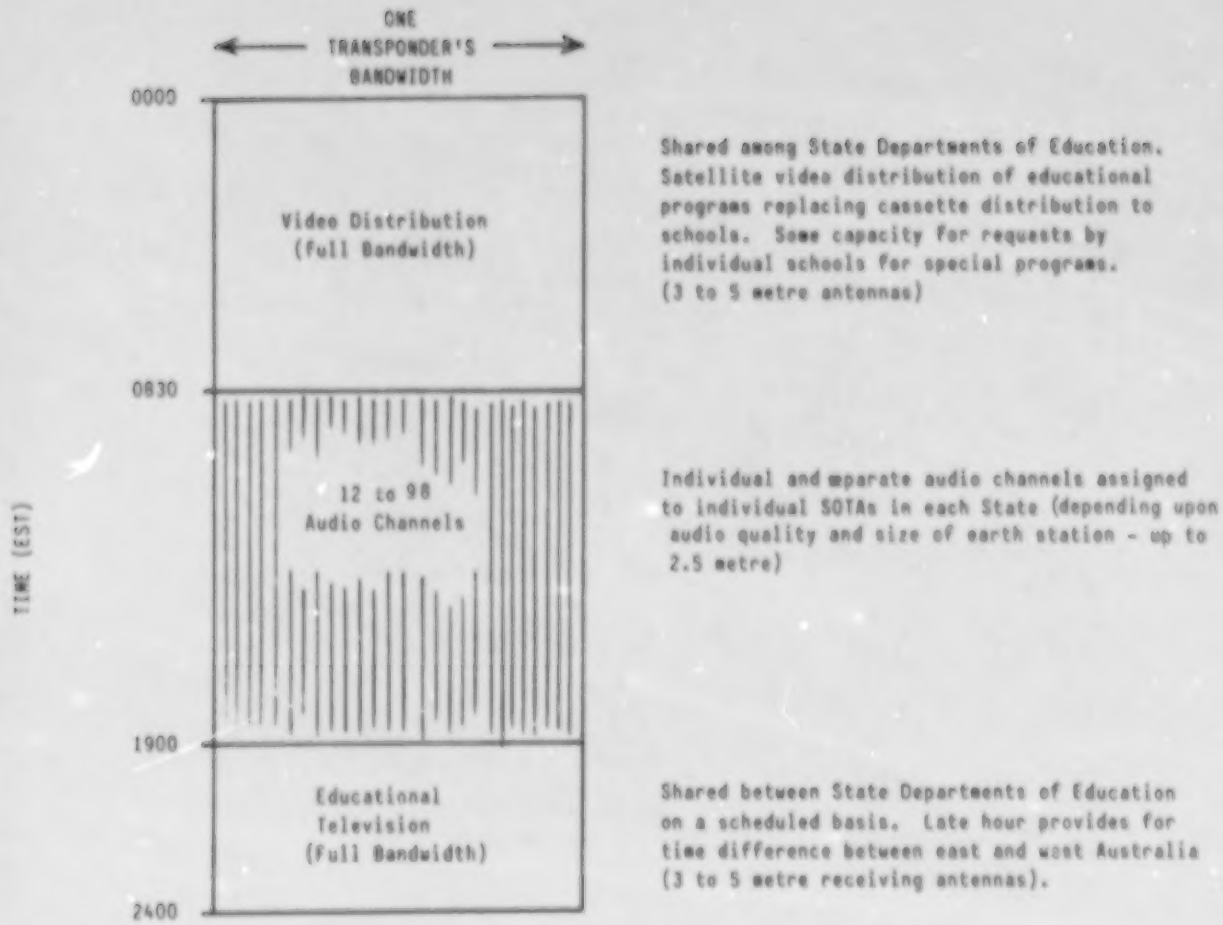
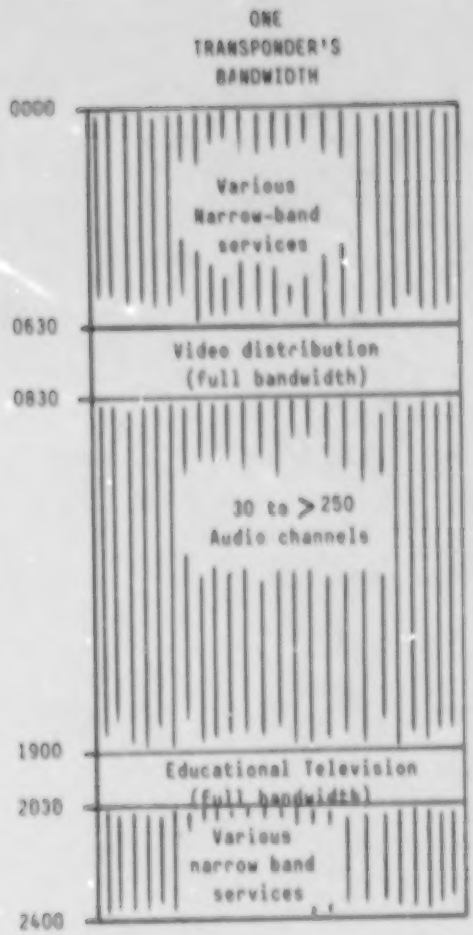

ONE TRANSPONDER'S BANDWIDTH
0000
Video Distribution (Full Bandwidth)
0830
12 to 98 Audio Channels
1900
Educational Television (Full Bandwidth)
2400
TIME (EST)
Shared among State Departments of Education. Satellite video distribution of educational programs replacing cassette distribution to schools. Some capacity for requests by individual schools for special programs. (3 to 5 metre antennas)
Individual and separate audio channels assigned to individual SOTAs in each State (depending upon audio quality and size of earth station - up to 2.5 metre)
Shared between State Departments of Education on a scheduled basis. Late hour provides for time difference between east and west Australia (3 to 5 metre receiving antennas).

FIGURE 6.3 : Notional utilisation of a 12 watt-transponder in the national beam

INDICATIVE 12-WATT TRANSPONDER USES
(North-eastern Zonal Beam)



Narrow band channels used by State Government or other users

Satellite video distribution of educational programs replacing the existing videocassette distribution to schools. Some capacity for requests by individual schools for special programs (1.6 to 2.6 metre antennas)

Queensland SOTA channels plus narrow band services for State Government departments or other users (depending upon audio quality and size of earth station antenna - up to 2.5 metre).

Educational television services for isolated schools. Possibly incorporating an interactive audio link.

Narrow band channels used by State Government departments or other users

FIGURE 6.4 : Notional utilisation of a 12-watt transponder in the North-eastern zonal beam

Between 1900 hours and 2030 hours, the whole transponder could be used for interactive educational television and between 0630 hours and 0830 hours for television distribution to tape recorders. Earth stations having antenna diameters of 1.6 metre to 2.6 metre would be required to receive this signal; rather smaller than those needed in the national beam.

The choice between the use of a 12 watt transponder in a national or zonal beam can only be made after an adequate assessment of:

(a) the combined needs of the State Departments of Education;
(b) the degree to which the Commonwealth Department of Education would participate in a co-ordinating role;
(c) the needs of other State organisations for shared use of a zonal transponder;
(d) the technical views of AUSSAT;
(e) the comparative costs of the two options to a State Department of Education taking into account earth station factors; and
(f) the financial resources of the individual States.

Use of the Rural Telephone Service

The cost of providing all students with transmit/receive earth stations may make it cost effective to use the telephone to reach some SOTA students. As discussed previously, private line service will be a prerequisite for the use of telephones for educational purposes.

Telecom Australia is improving the rural telephone service through the introduction of the Digital Radio Concentrator System (DRCS) in 1984-85 and the Remote Television Satellite Service (RTSS). The DRCS is the major technology to be used to provide an automatic STD service to rural customers. Telecom Australia anticipate substantial completion of this program by 1990. The RTSS will also be available from 1985 to provide high quality telephone links.

The DRCS consists of chains of radio repeaters which provide the links to gather customers into groups and connect them to the switched telephone network. Each chain will service some 100 customers through shared access to some 15 circuits. When using

the telephone, each customer will have a private line. However, when initiating a call there will be some possibility that a free circuit will not be available and the customer on the DRCS chain will get a network congestion signal. The rather long duration of some 30 to 60 minutes required for an educational (compared to a normal) telephone call will increase the likelihood of trunk overload, and could degrade to some extent the service to other customers served by the chain. This would be undesirable. The potential for overload due to the use of the telephone for educational purposes can only be assessed by Telecom Australia when some operational experience with the DRCS has been accumulated, the configuration of the DRCS chains in the Mount Isa area are identified and the educational requirements are specified. The way in which the educational needs are met can be negotiated with Telecom Australia.

The RTSS, using the ACSS, will provide some 200 circuits per transponder to service up to 2000 rural customers depending upon location. With this larger number of circuits and customers, the loading effects of educational use will be less noticeable. However, this loading will have to be assessed by Telecom Australia as experience is gained and the educational requirements are defined. Connection fees and call charge rates for the RTSS have not yet been established by Telecom Australia.

Call charges for DRCS-provided services will be under Telecom's normal charging arrangements. In the Mount Isa area this would be the Countrywide Calling Scheme wherein calls made from the SOTA coverage area would be Subscriber Trunk Dialling (STD) rates on a zone-to-zone basis. Those students in the Barkly zone immediately surrounding the Mount Isa zone would pay the Community Access rate (15 cents for 3 minutes as of 1 October 1983). Other zones in the SOTA region have this level of access to other Community Service towns and, hence, would not benefit from this lower rate.

A 008 Service (formerly known as INWATS) is an arrangement under which the called party is billed for all incoming long distance calls at a fixed rate for all calls from within a specified region (eg Queensland). The SOTA teacher with this service would have a conference bridge which could be called by participating students at a pre-arranged time. Students would then pay only for a local call while the SOTA was billed for the remaining call charge.

Traditional School of the Air transceiver

HF Radio

The performance of the HF radio links is marginal at present. However, a number of improvements could be made to upgrade the level of service to those students who continue to use the HF radio:

(a) Antenna installations which are typically made by inexperienced people are a major limitation. The antenna should be installed by a trained person and tested to confirm the achievement of design performance.

(b) The transceivers should be operated from mains supplies wherever this is available. Where it is not, a rechargable battery pack should be provided, preferably not interchangable with a car battery.

(c) Maintenance of a daily record of the quality of the links to each student would assist in the identification of problem areas which could be corrected during a visit to the student installation by a technically oriented person.

Detailed Technical Factors

Reference is made to Appendix A for a discussion of some of the technical factors related to the satellite links. Development of budgetary cost figures for an operational service and any trial service will need to be addressed in detail between the Queensland Department of Education and AUSSAT.

6.3 Implications of the Preferred Scenario

Organisational considerations contained in the preferred scenario draw upon existing administrative units to minimise the impact of change on the teachers, students and Home Tutors involved in North-west Region distance education. It has been argued in this Report that adoption of the strengthened regionalism scenario would help to reinforce existing services by providing a functional regrouping.

The technical discussion in section 6.2 about the use of a 12 watt transponder in the national beam gives rise to a range of possible cost sharing arrangements among the State and Commonwealth Departments of Education. In the early years of the ACSS life cycle (say, from 1986 to 1988), there would be a developmental period for satellite-based educational services.

The shared use of a national beam transponder does not take away the autonomy of a State or Territorial Department of Education from using its portion of the transponder for audio channels in the manner it determines. Television channels, however, use a whole transponder and a special arrangement would be needed for sharing the educational television allocation.

CHAPTER 7

A TRIAL INTRODUCTION OF IMPROVED SERVICE

7.1 Need for a Trial

The present SOTAs have a long history of successful delivery of distance education services to children of primary school age using HF radio. These operational links cannot be abandoned in favour of an apparently attractive but untried technology. The environment of the SOTAs in Australia is unique and there is a number of uncertainties about the best implementation and utilisation of a new system and its cost structure.

In many disciplines, trials are undertaken to gain familiarity with a new system and to reduce uncertainties in planning for its implementation and utilisation. The purposes for any trial are generally as follows:

(a) to develop greater understanding of the application of a technology through the experience of detailed planning for its use in a structuured situation;

(b) to identify problem areas which could impact on operational implementations;

(c) to demonstrate to decision-making levels the use of the system and the structure of a particular implementation in order that future applicability can be assessed on the basis of direct experience;

(d) to demonstrate the various facets of the system to the people who will be involved in its use (i.e. teachers, students, parents, inspectors, administrators);

(e) to provide a basis for planning the phased introduction of a new service;

(f) to provide for an evolutionary introduction of the new service, starting with the trial itself, arranged in a manner such that further introduction can be aborted should the results not be found to commensurate with the costs.

A trial system at Mount Isa could consist of the following elements based on the use of a 12 watt transponder operating in the national beam:

(a) one 4.5 metre uplink earth station at the Mount Isa SOTA equipped to provide two or three voice channels;

(b) ten 2.5 metre student transmit/receive earth stations installed at the homes of selected students;

(c) ten to twenty 1.5m to 2.5m receive-only earth stations capable of receiving the voice signals originated in Mount Isa;

(d) suitable interface facilities at the Mount Isa SOTA to provide for incorporation of responses from individual students using satellite, telephony and HF radio links;

(e) educational television related to skills development transmitted to isolated schools or other learning centres.

Additionally, educational television might be transmitted using the 30 watt HACBSS transponders to individuals with a standard 1.5 metre HACBSS earth station.

AUSSAT has offered to participate in a trial.

7.2 Educational Elements

The Queensland Department of Education might consider the development of a detailed structure for the implementation of a trial.

Such issues as the following would need consideration:

(i) decentralisation of existing services;
(ii) management of a restructured service;
(iii) staffing and associated matters;
(iv) patterns of interactions.

Implications for the total Distance Education Service in the North-west Regions (and other Regions) might be examined.

Some indication of the work necessary to conduct a trial is given in a simplified form in Figure 7.1. The period leading up to the trial is involved with planning and equipment installation. The evaluative phase which is a necessary part of any trial might usefully incorporate a before-and-after analysis of the situation.

Objectives for a trial might be:

a) To test the use of the ACSS with the Mount Isa SOTA and other applications to improve distance education services.

b) To test and evaluate revised concepts and administrative structure in distance education which take advantage of improved communication technology.

c) To obtain an appreciation of the applications of satellite communications technology at all levels in the Department of Education.

d) To obtain solidly based information on costs and service effectiveness.

e) To develop the base of a future operational system should this prove to be practicable and cost effective.

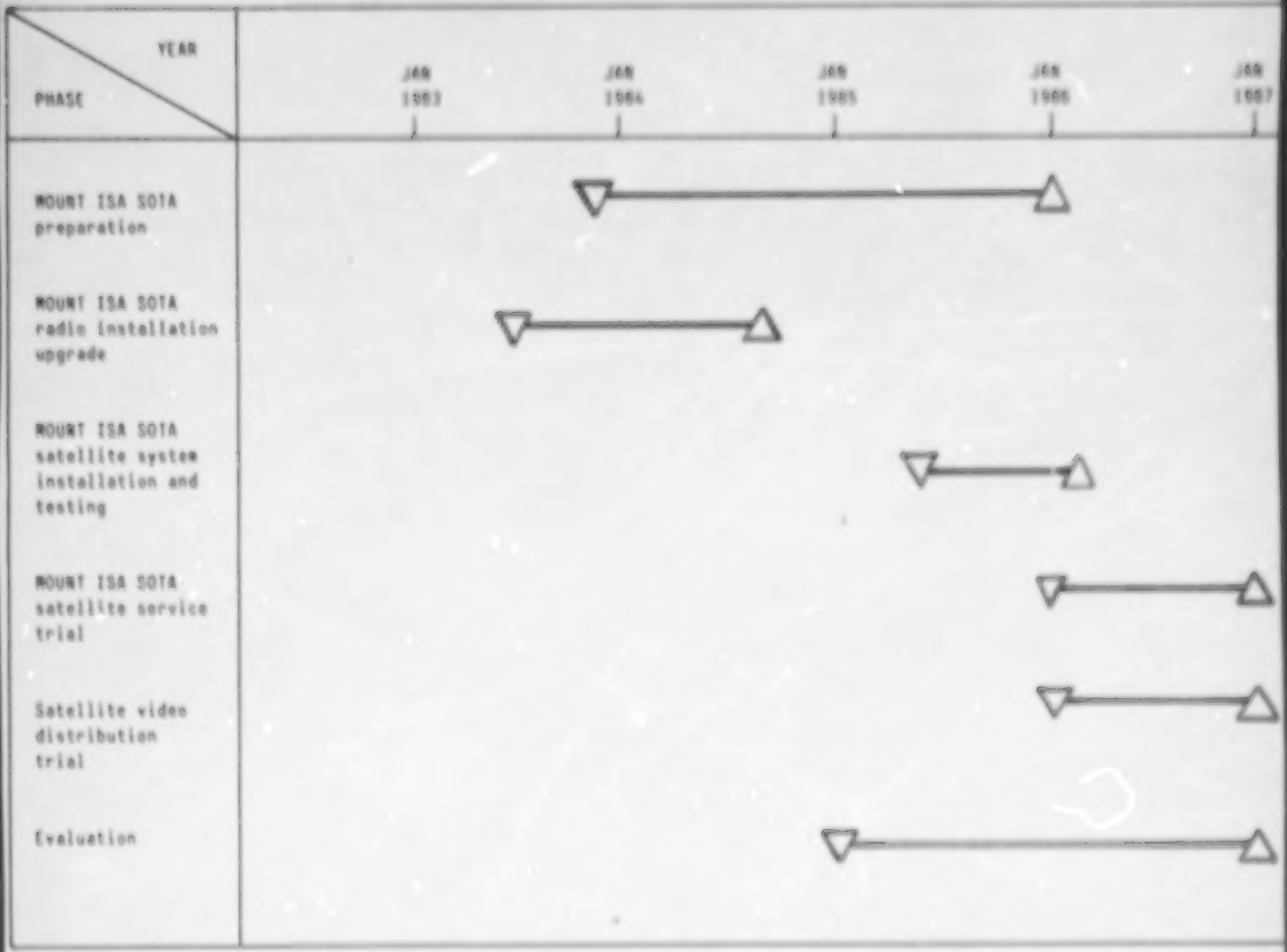


FIGURE 7.1 : Outline of activities for a Mount Isa SOTA satellite trial

CHAPTER 8

RECOMMENDATIONS

It is recommended that:

(a) The Queensland Department of Education:

(1) Assess the desirability of entering into a one-year trial service to commence in January 1986;

(2) Enter into discussions with AUSSAT on the terms and conditions for a trial;

(3) Plan, in co-operation with the Advisory Committee and other interested Departments of Education, the initiation of operational services in an evolutionary fashion in January 1987.

(b) The Advisory Committee:

(1) Note this report and make it widely available within the educational community to provide a basis for ongoing discussion of the educational use of the ACSS.

(2) Assess the merits of the use of the ACSS for educational purposes and comment upon the:

- potential role of the commonwealth Department of Education in the future use of the ACSS
- organisational and political merits of zonal and national beams for SOTA and other Distance Education applications
- investigative activity that would complement a SOTA field trial at Mount Isa (eg use of the HACBSS or 12 watt transponders for educational television)
- capacity requirements of Distance Education.

(3) Request the Federal Minister for Education and Youth Affairs to:

- note the plans for a trial service
- seek the advice and assistance of other Ministries in the organisation and implementation of satellite-based educational services
- press for recognition of appropriate access by educational authorities to the capacity of the ACSS 12-watt and 30-watt transponders.

From the analysis presented in this report, it is proposed that planning for the use of the ACSS for SOTA and other distance education purposes be based on the following technical factors:

- use a 12 watt transponder operating in a national beam;

- shared use between State Departments of Education; a suitable co-ordinating agency or the Commonwealth Department of Education being responsible for the lease and scheduling of the transponder;

- dedicated uplink facility (earth station with 4.5m antenna) at each SOTA capable of providing the required number of voice channels;

- provision of 1.8m to 2.5m transmit/receive earth stations for most students;

- provision of 1.5m to 2.5m receive-only earth stations for those students whose situation is not suitable for a transmit/receive earth station and telephone or HF radio for return links;

- telephone quality satellite voice communication links rather than higher quality ones.

APPENDIX A

SATELLITE LINK DESIGN
FOR
SCHOOL OF THE AIR
AND
ENHANCED EDUCATIONAL USES

1. Introduction

The ACSS will consist initially of two active satellites each of which will have eleven 12 watt transponders and four 30 watt transponders. Communications signals transmitted to the satellite from earth stations (uplink stations) are amplified and retransmitted by the individual transponders in the satellite to receiving earth stations (downlink stations). The satellite receives signals in the frequency band 14.00-14.50 GHz and transmits them in the frequency band 12.25-12.75 GHz. Each of the transponders operates in a different fraction of the uplink and downlink bands.

The individual transponders can be connected to radiate a signal which covers either all of Australia or certain of four separate zones. Figure A1-1 shows the national coverage and Figure A1-2 shows the NE zonal coverage. On the figures is shown the signal powers that are radiated. The larger signal powers can be received with smaller antennas (and vice versa).

The 30 watt transponders are designed principally to operate in the zonal beams to broadcast television and radio programs to small low cost receive-only earth stations in the Homestead and Community Broadcasting Satellite Service (HACBSS). The HACBSS-1 will provide a regional ABC television service and two or three ABC radio programs to each of the zones. The proposed HACBSS-2 could provide some form of commercial, subscription or other alternative television and radio programs. The 30 watt transmit power together with the concentrated zonal beam will permit individuals to receive signals with earth stations having antennas of 1.2 to 1.5m diameter and costing about $1,000. The 30 watt transponders are also switchable into the national beams and may, as an alternative to the HACBSS-2, be used to provide program distribution to more costly earth stations having larger antennas of 3 to 8m diameter.

The 12 watt transponders are designed principally to provide for the distribution of television and radio programs (a point-to-multipoint service), and trunk telephone and data signals between identified locations (a point-to-point service) using the portion of the frequency band assigned for the Fixed Satellite Service (FSS). The main distinction between the broadcasting and the fixed services is whether the intention is for reception by members of the general public (HACBSS) or for private communications between identified parties or locations (FSS).

The particular satellite links which could be used for educational purposes related to the SOTAs and to the enhanced educational services considered in this report are the following:

(a) Part-time use of the 30 watt HACBSS or 12 watt transponders for educational television for immediate use or for video tape recording for use later.

(b) Use of a 12 watt transponder in a zonal or national beam for teacher-to-student links.

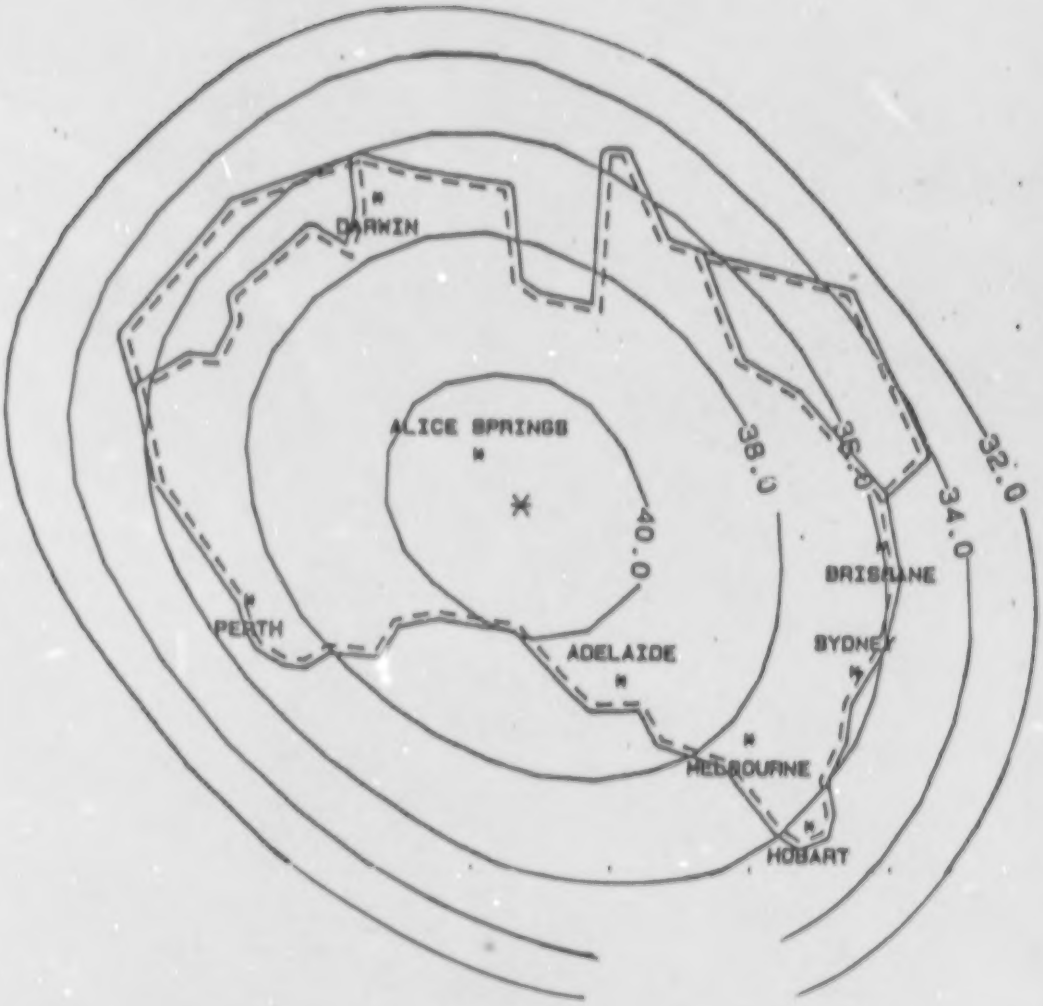


FIGURE A1-1 : Satellite Footprints for the national beam with a 12 watt transponder (contours of constant power level in dBw units)

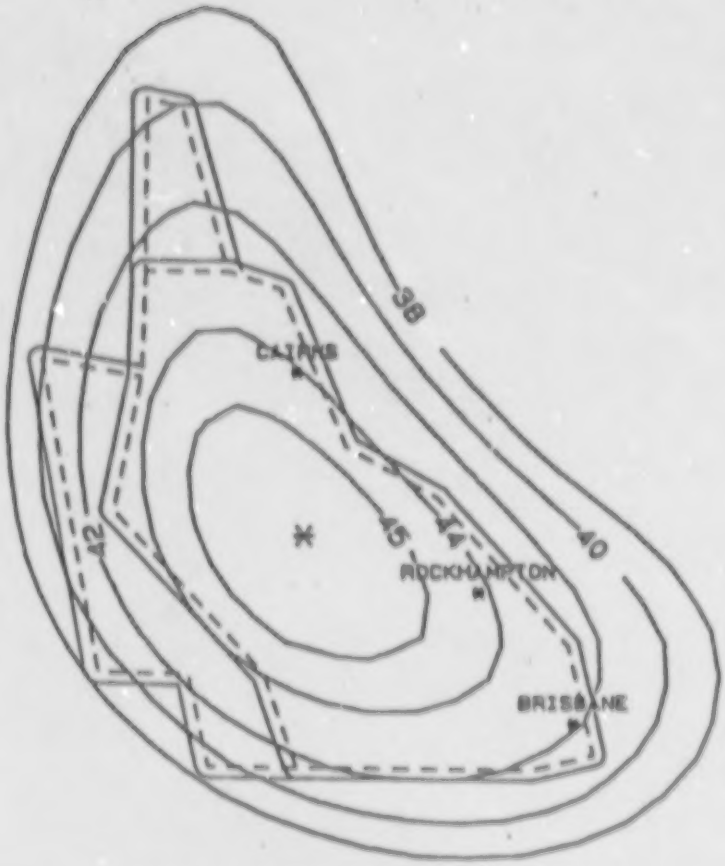


FIGURE A1-2 : Satellite footprint in NE Zone showing the radiated power for a 12 watt transponder operating in the zonal beam (contours of constant power level in dBw units)

(c) Use of a 12 watt transponder in a zonal or national beam for student-to-teacher links.

Further work during a field trial will be needed to determine if other kinds of satellite links are needed. The technical aspects of each of the above communications links are developed in the following sections.

2. Use of 30 watt HACBSS or 12 watt Transponders for Educational Television

As discussed previously, the 30 watt transponders are designed to broadcast a television and associated audio signals for reception by earth stations with 1.2 to 1.5m antennas. The quality of the signal will be roughly equivalent to that received by individuals off-air from a terrestrial broadcast transmitter or provided by a well adjusted video cassette recorder (VCR). A higher quality signal suitable for retransmission or distribution by cable throughout a school or a building housing an administrative organisation could be provided by using a larger antenna. Annex 1 contains an analysis of the HACBSS television link. Based on this analysis, Figure A1-3 shows contours to indicate the sizes of earth stations required to receive HACBSS television in different regions of the NE zone.

The 12 watt transponders are too low in power to be used for television broadcasting but can be used effectively to distribute television programs to larger earth stations at schools or administrative centres. Such use of 12 watt transponders would have some attraction if the SOTA educational services were provided through a 12 watt transponder, and use of such a transponder were time-shared between the different educational services.

Annex 2 contains an analysis of a television link using 12 watt transponders. It is shown that an earth station with a 3.0 to 5.2m antenna (the size depending upon the geographic location) would be required to receive HACBSS quality television from the national beam. If the 12 watt transponder were operated in a zonal beam, a smaller antenna of 1.6 to 2.6m would be required to receive the signal. Figure A1-4 and A1-5 show contours to indicate the sizes of earth station antennas required to receive HACBSS quality television from the 12 watt transponders in national and NE zonal beams respectively.

3. Use of Audio Channels in a 12 Watt Transponder for Teacher-to-Student Links in SOTAs

A satellite audio link can provide high quality audio signals with high reliability and would have transmission characteristics that would support data transmission and facsimile which might be required for enhanced services. The number of audio channels that can be provided depends upon the quality and bandwidth of the individual channels and upon the size of the receiving earth stations. A larger number of channels, and hence a lower cost per channel, can be provided with narrow bandwidth audio channels

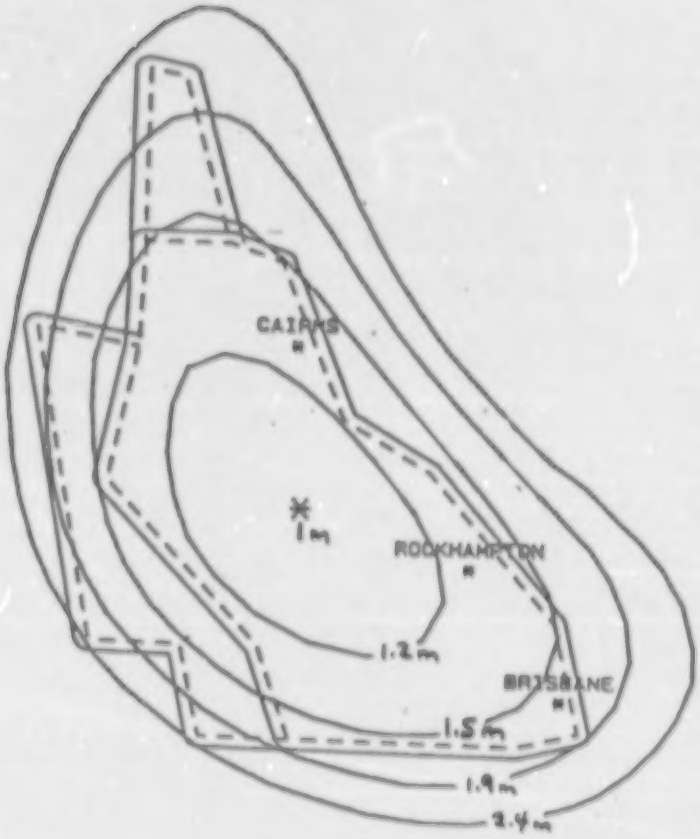


FIGURE A1-3 : Contours showing the diameter of earth station antennas required to receive HACBSS television and sound programs (30 watt transponder)

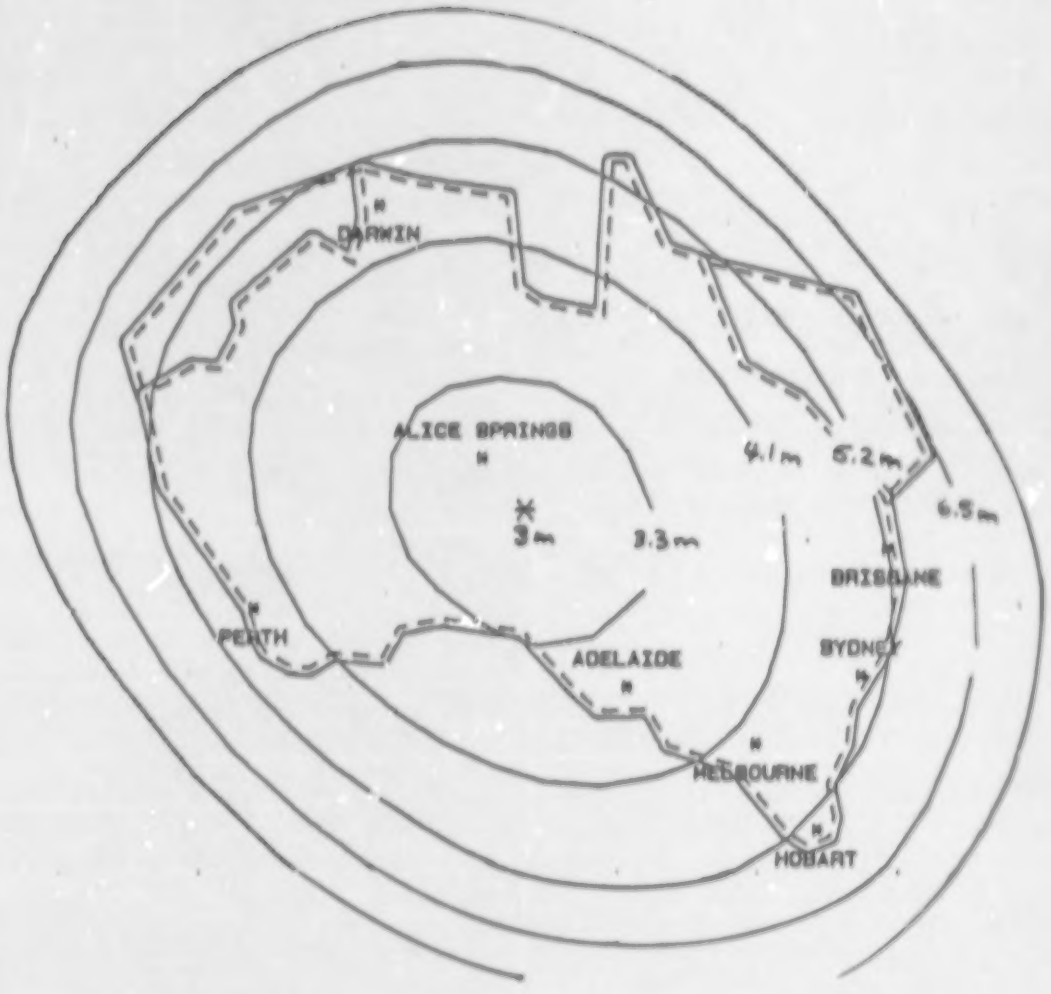


FIGURE A1-4 : Contours showing the diameter of earth station antennas required to receive television with a 12 watt transponder operating in the national beam

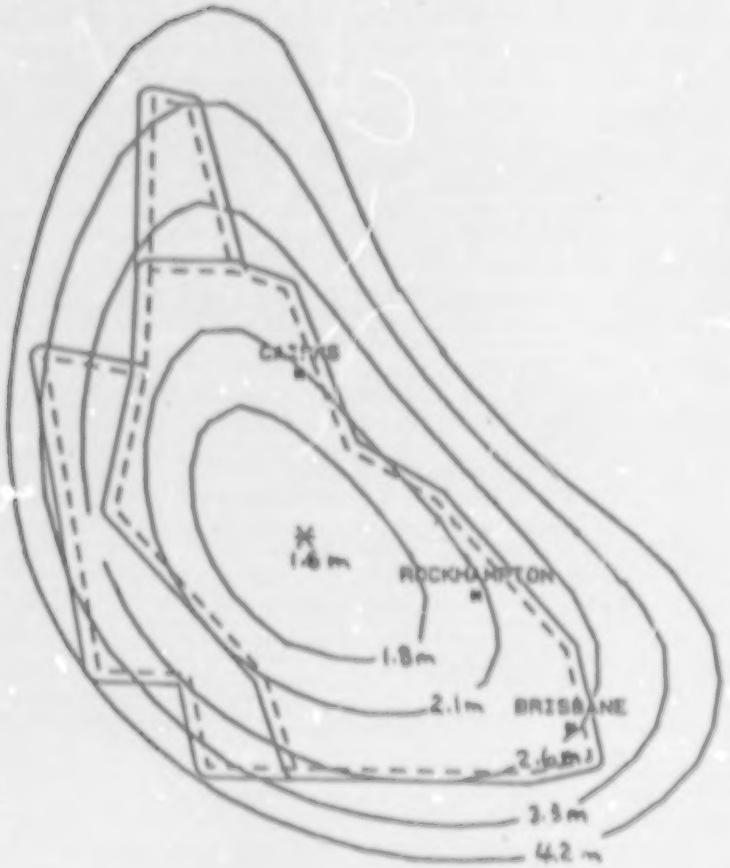


FIGURE A1-5 : Contours showing the diameter of antennas required to receive television with a 12 watt transponder operating in the NE zonal beam

(e.g. a 3 kHz telephone bandwidth, rather than a 5 kHz AM radio bandwidth) and a larger diameter antenna (e.g. a 2.5m antenna, rather than a more easily handled 1.5m). A very careful quality, cost and operational flexibility trade-off study must be made between the quality of the links, the annual cost per audio channel of the links and the capital and handling costs of individual earth stations.

Annex 3 contains detailed link calculations to establish the number of teacher-to-student links with AM radio or telephone quality that could be accommodated in one 12 watt transponder in either a zonal or national beam to be received by either a 1.5m HACBSS type earth station or a 2.5m earth station.

The 1.5m HACBSS earth stations are designed to receive ABC television and 2 or 3 ABC radio programs and are expected to cost less than $1,000. The reception of the SOTA audio channel is similar to the planned reception of the ABC radio programs except that the bandwidth will be lower and hence a different voice channel demodulator will be required.

The addition of a voice channel demodulator to the basic HACRSS earth station is expected to raise the cost of the earth station by perhaps $400 leading to a total earth station cost of $1,400. The use of a larger 2.5m antenna could increase the cost to about $3,000.

The individual SOTA transmissions would be single-channel-per-carrier (SCPC) with multiple carriers in one transponder. For purposes of analysis, frequency modulation is assumed as this is widely adopted and hence a wide variety of equipment is available to choose from. There could be advantages in the use of a digital form of modulation, although it is less well developed at this time. There would not be a large change in the number of links. Digital modulation should be examined at a more detailed stage of the design. The Table in Figure A1-6 summarizes the results.

Figure A1-6 Number of Simultaneous* SCPC Teacher-Student Links Using 2.5m and 1.5m Receiving Earth Stations

Quality of Link	12W Zonal Beam		12W National Beam	
	2.5m	1.5m	2.5m	1.5m
5kHz bandwidth with quality equivalent to AM radio	73	30	21	12
3kHz bandwidth with good telphone quality	>250	142	98	35

* Use of voice activation could provide some further increase in capacity.

This table indicates that the use of a 12 watt transponder in the NE zonal beam would provide far more capacity than the 9 channels now required by the three Qld SOTAs. The use of a national beam and 5 kHz AM radio quality would not provide enough capacity for all of the 12 SOTAs (18 channels presently) and any capacity for growth. Use of a national beam and telephone quality channels would provide sufficient capacity and is the approach recommended in Chapter 8 for a trial system .

A numbe- of aspects need to be considered in detail.

(a) The trade-offs between capital and channel lease costs in defining the size of the students' earth station antennas, together with the capability to use capacity surplus to that required by the SOTAs in a transponder.

(b) The quality requirement of the SOTAs given the trade-off between quality and number of channels and therefore lease cost/channel.

(c) The use of voice activation (activating the transmitter only when someone is speaking, as employed in satellite telephony systems) could nearly double the number of channels. However, some experimental testing with voice activation would be needed to assess any adverse effects on the teachers' signals and to confirm the assumed activity factors.

There is one technical complexity which should not be forgotten. HACBSS television and sound programs will be transmitted to four zones with two different polarizations from two different satellites. The configuration will be determined when AUSSAT assigns transponders to particular services. SOTA or other educational programs transmitted in a national beam would be transmitted from one satellite with one polarisation (as determined by the assignment of HACBSS and SOTA transponders). HACBSS earth stations in one of the zones could receive SOTA signals by tuning to the SOTA transponder. In another zone, to receive the SOTA signals, the polarization of the HACBSS receiving antenna feed would have to be rotated or switched. In the other two zones, to receive the SOTA signals, the HACBSS antenna would have to be swung to point towards the other satellite with some adjustment or switching of the polarization. Because of these factors, it could well be cost effective to have a separate earth station at students' homes to receive SOTA signals, in addition to the one owned by the family to receive HACBSS signals.

4. Use of Voice Channels in a 12W Transponder for Student-to-Teacher Links

The link from the student to the teacher is the more difficult to improve using the satellite because student uplink transmitters are much more expensive than the downlink receivers. This is due to the accuracy required for the transmit frequency, the high

cost of the transmitter power amplifier and the size of antenna required both to access the satellite and to reduce the interference to adjacent satellites to an acceptable level.

AUSSAT have specified a "minor earth station" for procurement that would have suitable characteristics. Basically, this a telephony terminal without the telephone interface equipment. It would typically have a 2.5m antenna, and a 1 watt solid state power amplifier. Antennas as small as 1.8m could be feasible for specific applications provided they meet interference criteria, to be specified by AUSSAT that would provide sufficient protection for other satellite services. Considerable work is underway in companies in many countries to develop low cost telephony earth stations. In 1975, these earth stations cost $100,000 each. In January 1983 the press reported signing by AUSSAT of contracts totalling $1m with three suppliers for a total of 21 minor earth stations to be delivered in 1985. This indicates an average unit cost of about $50,000 but the marginal cost of an additional earth station is much less than this. There are confident projections by AUSSAT and Telecom Australia that the unit cost of a telephone earth station when more than ten earth stations are procured from a single supplier is $25,000. In quantities of 100 therefore, (using an empirical costing rule that increasing production by a factor of 10 halves the per-unit cost) the cost should be less than $15,000 per unit. For SOTA applications, it could be possible to take advantage of developments to further reduce costs resulting in specialised transmit/receive earth stations costing less than $10,000.

For the student-to-teacher return links, it is important to reduce the cost of the student transmitting earth stations as it would not be appropriate to have high cost equipment at student's homes and the total capital costs would have to be met by the Department of Education. The minimization occurs for the lowest channel bandwidth. Hence only 3 kHz telephone voice quality channel is considered.

Annex 4 contains an analysis of the communications links for the student uplinks and for SOTA downlinks which shows the basic feasibility of the use of an earth station at the students' homes with either a 1.8m or 2.5m antenna. The difference between these two antenna sizes is not so much the cost of the antenna as the difficulty and associated cost of transporting and installing the antenna on a homestead. The latter probably is much lower for a 1.8m than for a 2.5m antenna.

It should be noted that the design for a 1.8 m antenna depends upon having the students transmit back to a 4.5 m earth station at the SOTA (a star network arrangement.) The 1.8 m earth station could not be used for direct student-to-student communications (a mesh network arrangement). However, other factors such as the considerably greater switching and management requirements of a mesh network would prelude use of such a network for a SOTA.

The amount of transponder power required for the student response links for the 18 SOTA classes is estimated in Annex 4 as 7%-8% of the total transponder power. Therefore it would be quite practical to accommodate these links within the same transponder as used for the teacher-to-student links. A very careful design would be required to establish exactly the sharing of the transponder and the optimization between the size of the antennas for the student earth stations and for the SOTA station.

It is recognised that the cost of installing a transmitting earth station at the homestead of a student is high. To contemplate installing earth stations to replace all the HF sets used by the SOTAs, approximately 950, would result in a greater utilisation of such earth stations than for any other presently planned purpose. It appears therefore to be unrealistic to propose satellite uplinks at every homstead. Rather, their introduction must be evolutionary.

5. Summary

Figure A1-7 is a tabular summary of the earth stations required to perform the different communications functions.

FIGURE A1-7

SUMMARY OF EARTH STATION PARAMETERS

Communications Function	Earth Station
Reception of Educational Television from 30W HACBSS transponders	1.2m to 1.5m HACBSS Television receive only
Reception of Educational Television from 12W Transponder in NE Zonal Beam	1.6m to 2.6m Television receive only
Reception of Educational Television from 12W Transponder in National Beam	3.0m to 5.2m Television receive only
Student reception of SOTA teacher's voice transmission	1.5m HACBSS to 2.5m earth station modified to receive a voice channel
Student transmit/receive SOTA earth station	1.8m to 2.5m transmit/ receive earth station
SOTA multi-channel voice transmit/receive	4.5m (minimum) multi-channel transmit/receive earth station

It should be noted that the analysis indicates that the most realistic quality objective for the SOTA channels is a telephone quality in order to produce sufficient capacity within one transponder to meet the anticipated requirements of the SOTAs.

ANNEX 1

LINK ANALYSIS FOR NACBSS-TELEVISION

The following analysis will detail the design for the NACBSS-Television service.

Edge of Coverage EIRP	(dBW)	47
Output Back-off	(dB)	-1
Free Space Loss	(dB)	-206.29
Atmos Attenuation	(dB)	-0.2
k	(dB/Hz-K)	228.6
Earth station G/T (1.5m; NF=3.5dB; See Annex 3-1)	(dB/K)	16.0
Downlink C/N_0	(dB-Hz)	84.11
Sound Program Intermod C/I_0	(dB-Hz)	96.0
Total C/N_0	(dB-Hz)	83.84

Video Demodulator

Peak Frequency Deviation (Δf)	(MHz)	7.1
Baseband Bandwidth (f_m)	(MHz)	5.0
FM Improvement Factor $(3/2\ (\Delta f)^2\ 2/f_m^3$	(dB)	-62.18
Conversion rms signal to p-p video	(dB)	6.12
Pre-emphasis Gain	(dB)	2
Implementation Margin	(dB)	-1
Video SNR (p-p video/rms unweighted noise)	(dB)	26.78
Receiver Noise Bandwidth	(MHz)	17.5
Receiver CNR	(dB)	11.41

LINK ANALYSIS FOR TELEVISION DISTRIBUTION USING 12W TRANSPONDERS

The following analysis will be used to determine the size of earth station antenna required to receive a television signal. (See Annex 3 for appropriate notes)

		ZONAL BEAM	NATIONAL BEAM
Edge of Coverage EIRP	(dBw)	42	36
Free Space Loss (12.6 GHz)	(dB)	-206.29	
Atmos Attenuation	(dB)	-0.2	
k	(dB/Hz-K)	+228.6	
Downlink (C/N_o - earth station G/T)	(dB-Hz-K)	64.11	58.11
Video Demodulator			
Peak Frequency Deviation (Δf)	(MHz)	7.1	
Baseband Bandwidth (f_m)	(MHz)	5.0	
Required SNR (p-p video/rms unweighted noise)	(dB)	30.0	
FM Improvement Factor $(3/2\ (\frac{\Delta f}{f_m})^2_3)$	(dB)	-62.18	
Conversion rms signal to p-p video	(dB)	-6.12	
Pre-emphasis gain	(dB)	-2.0	
Implementation Margin	(dB)	1.0	
Required C/N_o	(dB-Hz)	85.06	
Receiver Noise Bandwidth	(MHz)	17.5	
Receiver CNR	(dB)	12.63	
Required Earth Station G/T	(dB/K)	21	27.
Receiving System Temperature (NF of 3.5 dB)	(dB-K)	25.60	25.60
Ageing Allowance	(dB)	0.5	0.5
Pointing Error	(dB)	1.0	1.0
Required antenna gain	(dB)	48.10	54.10
Antenna diameter (55% eff 12.6 GHz) at edge of coverage	(m)	2.6	5.2
Antenna diameter at boresight (EIRP = 46 and 40.7 dBw respectively)	(m)	1.6	3.0

ANNEX 3

CALCULATION OF NUMBER OF AUDIO PROGRAM CHANNELS OF SPECIFIED QUALITY

Critical factors in the design of the audio channels are the quality required of the link and the size of the earth stations. In this section, calculations are carried out to derive the number of voice channels of 5 kHz (AM radio) or telephone quality that could be provided in a 12 watt transponder operating in a zonal or national beam with receiving earth stations having a diameter of 1.5 and 2.5 metres.

5 kHz PROGRAM CHANNELS - COMPANDED

Earth Station Antenna Diameter		12W TRANSPONDER ZONAL BEAM 2.5m	1.5m	NATIONAL BEAM 2.5m	1.5m
Edge of Coverage EIRP	(dBw)	42		36[1]	
Output Back-off[7]	(dB)	-3.0	-2.80	-2.8	-2.0
Free Space Loss[2]	(dB)	-206.29		-206.29	
Atmos Attenuation	(dB)	-0.2		-0.2	
Earth Station G/T(see Annex 3-1)	(dB/K)	20.4	16.0	20.4	16.0
k	(dBW/Hz-K)	228.6		228.6	
Multiple Signal C/N_o(downlink)	(dB-Hz)	81.51	77.31	75.71	72.11
DEMODULATOR[3,4]					
Companded					
Full Load TT/N (Weighted)	(dB)	40.0		40.0	
Pre-emphasis and noise weighting	(dB)	0.0		0.0	
Implementation Loss	(dB)	-1.0		-1.0	
TT/N at discriminator	(dB)	41.0		41.0	
Peak Frequency Deviation	(kHz)	28.15		28.15	
Receiver Noise Bandwidth	(kHz)	66.30		66.30	
Required C/N_o	(dB-Hz)	61.22		61.22	
CNR[6]	(dB)	13.0		13.0	
Carrier/Intermod Ratio[5]	(dB)	18.0	19.1	19.1	35.0
CNR (downlink)	(dB)	14.65	14.22	14.22	13.1
C/N_o (downlink/carrier)	(dB-Hz)	62.87	62.44	62.44	61.32
Number of Carriers	(dB)	18.64	14.87	13.27	10.8
Number of Carriers		73	30	21	12

ANNEX 3

TELEPHONE QUALITY CHANNELS

		ZONAL BEAM		NATIONAL BEAM	
Earth Station Antenna Dia	m	2.5m	1.5m	2.5m	1.5m
Edge of Coverage EIRP	(dBW)	42.0		36.[1]	
Output Back-off[7]	(dB)	-3		-3	
Free Space Loss[2]	(dB)	-206.29		-206.29	
Atoms Attenuation	(dB)	-.2		-.2	
Earth Station G/T (See Annex 3-1)	(dB/K)	20.4	16.0	20.4	16.0
k	(dB H2-k)	228.6		228.6	
Multiple Signal C/N_o(downlink)	(dB-Hz)	81.51	77.11	75.51	71.11
C/N_o Demodulator[8]	(dB-Hz)	55.0		55.0	
Carrier/Intermod Density[9]	(dB-Hz)	63.0	64.0	64.0	
C/N_o (downlink/carrier)	(dB)	55.75	55.58	55.58	
Number of Carriers	(dB)	>24	21.53	19.93	
Number of Carriers		>250	142	98	35

ANNEX 3

NOTES

1. This level of signal is available at the edge of coverage. A signal level 1 to 4.7 dB higher could be expected over the interior region of greatest interest for the SOTAs.

2. Calculated at 12.6 GHz for the maximum satellite range. For the minimum range, the free space loss is 205.61 dB giving an additional margin of up to 0.7 dB.

3. With compandors the TT/N ratio is specified to be 40 dB without pre-emphasis or noise weighting. The subjective quality of the resultant audio signal is above 58 dB.

4. The calculation for the required C/N_o per channel is based on the FM equation:

$$TT/N = 3/2 \frac{\Delta f^2}{f_m 3} \cdot IM \cdot C/N_o$$

where TT/N is the full load rms test tone to weighted rms noise ratio

Δf is the peak frequency deviation

f_m is the highest baseband frequency

IM is the implementation margin, an allowance for non-ideal realization of the demodulator, usually taken as 1 dB for low-cost demodulators

C/N_o is the carrier to noise density ratio at the input to the demodulator

5. Exact calculations of the level of intermodulation products for many carriers are very difficult analytically. There is an optimisation between transponder back-off and the level of intermodulation products. For numbers of carriers less than 12, it is possible to choose channels which are free of 3rd order intermodulation products. For larger numbers these must be allowed for.
Levels of the intermodulation products calculated by AUSSAT using their computer model indicate that the intermodulation levels used in these calculations are conservative.

6. CNR chosen to be 13 dB, a little lower than that used for HACBSS 15 kHz sound programs.

7. Output back-off for about 100 carriers.

8. SCPC demodulators developed for telephony services are specified to provide telephone quality at this value of C/N_o (provides noise level 10,000 pW).

9. The similation did not cover numbers of carriers over 250 and therefore the calculations here are not extended above this value.

EARTH STATION G/T

Antenna Diameter		1.5 m HACBSS	2.5m
Ant Gain (12.6 GHz, 55% efficient)	(dB)	43.34	47.78
Pointing error allowance	(dB)	-1.0	-1.0
Ageing Allowance	(dB)	-0.5	-0.5
Receiver Noise Figure	(dB)	3.5	3.5
Receiving System Temp	(K)	370	370
Receiving System Temp	(dB)	-25.68	-25.68
Margin for other factors	(dB)	-0.16	-0.2
G/T	(dB/K)	16.0	20.4

ANNEX 4

LINK ANALYSIS OF STUDENT RESPONSE CHANNEL

The following is a calculation to determine the portion of a 12 watt transponder operating in a national beam that would be required to provide at response channels with 1.8 m or 2.5 m transmit/receive earth stations at the students' homesteads and a 4.5 m antenna at a SOTA.

The calculation shows that the use of a 1.8m student transmit earth station will not be feasible under the conditions assumed. However, use of a higher transmit power of 2 watts or demodulators with a better performance could make a 1.8 m earth station feasible.

The calcuation indicates that each response channel would require 0.37% to 0.44% of the full transponder power and hence that for 18 SOTA channels that 6.7% to 7.9% of the transponder capacity would have to be allocated for response channels.

The calculation indicates the approximate parameters for the student response channels. A very careful system design would be reeuired to optimise the design with respect to:

- the size to be used for the SOTA school earth station;
- the size to be used for the student earth station;
- the frequency allocation within a transponder for the teachers' channels and the students' response channels.

STUDENT RESPONSE CHANNEL

		DIAMETER OF STUDENT TRANSMIT ANTENNA			
		1.8m		2.5m	
Uplink					
Earth Station Tx Power (1 Watt)	(dBw)		0		
Coupling Losses	(dB)		-1.0		
Antenna Gain (4.5m 55% efficiency, 14.4 GHz)	(dB)	46.08		48.84	
Atoms. Attenuation	(dB)		-0.3		
Maximum Free Space Loss (14.4 GHz)	(dB)		-207.45		
Satellite G/T	(dB/K)		-2.0		
k	(dBw/Hz-K)		228.6		
C/N_o Uplink	(dB-Hz)	63.93		66.79	
Downlink (4.5m Earth Station)					
Edge of Coverage EIRP	(dBw)		36.0		
Total Output Back-off[2]	(dB)		-3.0		
Maximum Free Space Loss[1]	(dB)		-206.29		
Atmos. Attenuation	(dB)		-.2		
Earth Station G/T[3]	(dB/K)		27.8		
k	(dBw/Hz-K)		228.6		
Multiple Signal C/N_o	(dB-Hz)		82.91		
C/N_o Demodulator	(dB-Hz)		55.0		
Carrier/Intermod Density[2]	(dB)		58.0		
C/N_o Uplink (see above)	(dB-Hz)	63.93		66.79	
C/N_o Downlink	(dB-Hz)	59.31		58.64	
Fraction of total downlink power/ channel	(dB)	-23.60		-24.27	
	(%)	0.44		0.37	
Examination of Adequacy of Uplink EIRP					
Total input back-off for output back-off of 3dB[4]	(dB)	-6.0		-6.0	
Relative Back-off/ response channel	(dB)	-23.60		-25.27	
Total Back-off/carrier	(dB)	-29.60		-30.27	
Saturated $C/kT^5=C/No$	(dB-Hz)	93.14	±2.5	93.14	±2.5
Required Uplink C/No per Carrier	(dB-Hz)	63.54	±2.5	52.87	±2.5
Uplink Margin (Worst Cast)	(dB)	-2.1		1.4	

NOTES

1. Value calculated for the maximum range to a satellite (Satellite at 164°E from an earth station in the SW corner of Australia).

2. Detailed calculations of intermodulation products for a large number of carriers are best done through a simulation program. It is not possible to complete an exact calculation here because of the complex trade-off between output back-off, carrier-to-intermodulation product density ratio and the presence of carriers of different levels. The value of carrier-to-intermodulation product density used here is one selected from a number of calculations of SCPC operations carried out elsewhere.

3. The G/T value for a 4.5m antenna with a LNC having a oise figure of 2.5 dB with allowance for mispointing and ageing effects is 27.8 dB/K.

4. This value is between -6 and -8dB depending upon the saturation characteristics of the TWT.

5. The saturating flux density (SFD) is specified as being settable to -80, -85, -90 dBw/m^2 each $\pm$2.5 dB tolerance. The saturated C/kT is given by:

$$C/kT = SFD + G/T + \lambda^2/4 \text{ (dB)} - k\text{(dB)}$$
$$= 103.14, 98.14, 93.14 \text{ dB-Hz} \pm 2.5 \text{ dB}$$

C. J. Thoseson, Commonwealth Government Printer